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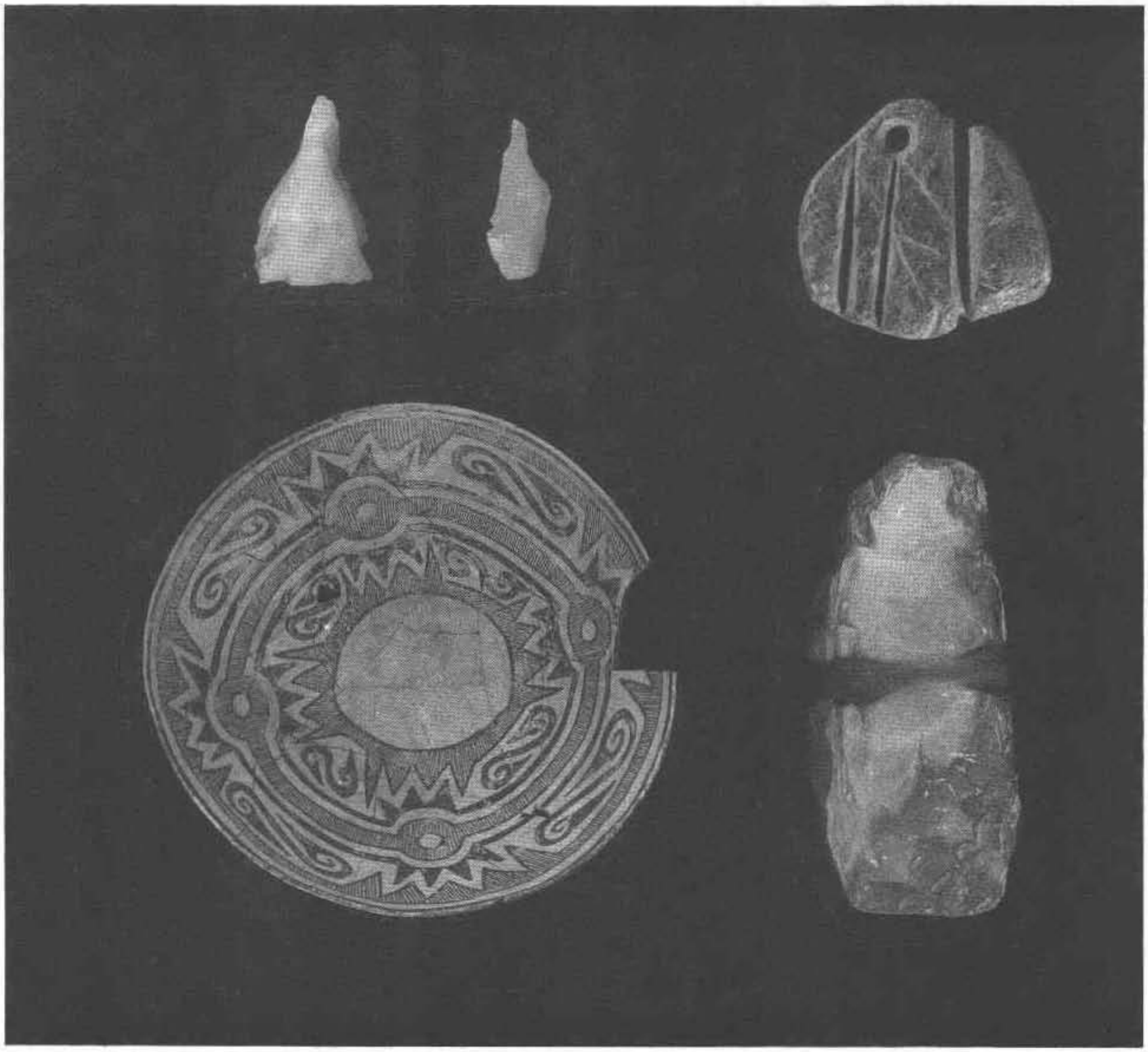
Vol. 1 of 3

Ceramics, Lithics, and Ornaments of

Chaco Canyon



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Front Cover:

1) *Chipped stone tools (FS 39/15 and FS 5) from 29SJ 1360 (NPS Chaco Archive Negative No. 32026).*
2) *Schist pendant (FS 204) from Pithouse C at 29SJ 628. (NPS Chaco Archive Negative No. 30918).*
3) *Gallup Black-on-white bowl (FS 4667) from the Trash Mound at Pueblo Alto (29SJ 389) (NPS Chaco Archive Negative No. 15900).*
4) *Axe (FS 1676) from the floor of Room 8 storage area at 29SJ 627 (NPS Chaco Archive Negative No. 31643).*

Back Cover:

1) *Corrugated jar (FS 77) from the fill of Room 5, House I, at 29SJ 1360 (NPS Chaco Archive Negative No. 13943).*

Ceramics, Lithics, and Ornaments of

Chaco Canyon

Analyses of Artifacts from the Chaco Project 1971-1978

Volume I. Ceramics

edited by
Frances Joan Mathien

Publications in Archeology 18G
Chaco Canyon Studies

National Park Service
U.S. Department of the Interior
Santa Fe, New Mexico
1997

MISSION

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. Administration.

March 3, 1849

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Preface

Disseminating the results of archeological projects is one of the most important missions of the National Park Service. To achieve this goal for its Chaco Project, two publication series were established: Publications in Archeology and Reports of the Chaco Center. Since the initial volumes appeared in 1976, over 18 reports have been completed in these two series—truly a bookshelf full of information. These series have been published under the guidance of several general editors and represent the efforts of many people working in various capacities who helped complete an exciting archeological project.

Pulling together some of the reports from the Chaco Project has been an interesting challenge. As one who came late, I have worked with the handicap of not having seen many of the sites during excavation or most of the artifacts in situ. In the late 1970s, when I was initially asked to analyze ornaments—one of the remaining artifact categories not yet being examined—I had only a broad overview of the Chaco Project and little realization of its actual size and scope. With the help of my colleagues, I soon became immersed in one small set of data. Seven years later, I was asked to guide the publications program to completion. My colleagues, especially Tom Windes and Jerry Livingston, were again great supporters. I learned much about the individual sites and the wealth of data contained in them, as well as the numerous explanations for their existence and changes through time. Nearly two decades after my initial introduction to Chaco Canyon, we are now approaching completion. This volume on Chaco artifacts will be the last in this series to present the work of some of the energetic and steadfast colleagues who made the project a success. The reports contained in this volume did not come easy; they are the sweat of many years!

As Robert Lister (former Chief of the Project) remarked during a teaching seminar at the University of New Mexico during the spring of 1975, the fun of archeology is in the fieldwork but the analysis and writing (done in labs and small rooms with only your intellect to guide you) are often tedious. During the Chaco Project, we were fortunate to have many dedicated archeologists who not only labored in the hot sun for long hours for many months, but who were also devoted to their profession. They had to be! First, excavation at many sites over the years produced such a large number of artifacts that the sheer volume alone would be enough to scare off those who were anything but intrepid. Second, most of the personnel had been hired on a part-time or term appointment basis which meant that unfinished reports or updates had to be completed after the individuals were no longer employed as part of the project. The contributors to this volume have proven to be exceptional people who have hung in until the end. These chapters are the completion of work which began two decades ago. To them I owe many thanks for additional years of writing, rewriting, and illustrating the reports contained herein.

I also want to thank several people who helped prepare the illustrations: Jerry L. Livingston, Ernesto Martinez, Linda Lutz-Ryan, Kent Bowser, John Hanttula, and my editorial assistant, Sarah Chavez. It is to Sarah that we owe the layout and uniformity of presentation of text and tables, especially the tables that are so long and so numerous. After Sarah left, Heidi Reed helped complete the final formatting. Eric Blinman and Dick Chapman reviewed our initial reports, made numerous helpful suggestions, and cleared up some theoretical problems. Kathy McCoy edited our prose. To these and the other members of the Chaco team, thank you.

For those who are interested in other aspects of Chaco prehistory, the Anthropology Program of the Intermountain Cultural Resource Center of the National Park Service maintains a list of related publications. Our collections and archives are housed at the University of New Mexico in either the Maxwell Museum of Anthropology or the Center for Southwest Research in Zimmerman Library. We hope the publications help you appreciate our national heritage and the cultural diversity that makes it so intriguing.

Foreword

Between 1971 and 1978, the National Park Service assembled a multidisciplinary research team to study the cultural and natural resources of Chaco Canyon, New Mexico. The number and location of sites recorded in the original archeological survey of Chaco Canyon National Monument and its environs led to passage of legislation in 1980 that expanded the boundaries of the monument and renamed the area Chaco Culture National Historical Park. It also provided protection for outlying Chacoan structures and surrounding prehistoric communities. Excavations at sites ranging in time from the Archaic through Navajo periods were carried out to understand the changes in cultures and the relationships with the environment, as well as with their neighbors.

In this seemingly harsh, semi-arid environment of northwestern New Mexico, most of the sites that were excavated as part of the Chaco Project are ancestral to the Pueblo peoples now living in the American Southwest. The time span ranges from A.D. 500 to A.D. 1200, a relatively long period during which sites in Chaco Canyon exhibit definite ties to others located on the Colorado Plateau. From A.D. 900 to A.D. 1150, however, sites in Chaco Canyon exhibit an unusual range of artifacts and architectural features, suggesting a major role in the social organization of these widespread groups. The architecture of major sites in the canyon has been documented in an earlier volume in this series, *Great Pueblo Architecture; Small Site Architecture* provides similar details for the house mounds excavated by many investigators over several decades, as well as by Chaco Project staff. In this volume, the reports focus on the artifacts recovered from large and small sites in an attempt to explain why Chaco was different from its neighbors for about 250 years and whether these differences are found in the material culture of small, as well as larger sites.

Based on the evidence, there was constant contact with neighboring groups on the Colorado Plateau through time; this is especially evident in the sharing of ceramic design styles. Based on the material types found among the chipped stone artifacts, ground stone implements, and ornaments, importation of goods is also demonstrated; yet, the amounts of material from these sources of imported goods changed through time, as did the forms in which they were carried into the canyon, e.g., raw materials versus finished items. The number of items imported, the directions from which they came, and the shared commonalities in design indicate that the prehistoric inhabitants of Chaco Canyon lived in a dynamic and changing society.

The analyses of ceramics, lithics, and ornaments presented in this volume are major contributions to the interpretation of the early Pueblo lifeways. The accomplishments of a people who relied on agriculture while living in a dry land where the amount of water available during specific periods of the year made a difference between starvation and success are many. I am pleased to introduce this volume which provides a wealth of information and numerous ideas on the development of technology and social organization of these early Pueblo people in our American Southwest.

Denis P. Galvin
Acting Deputy Director
National Park Service

ORNAMENTS

Chapter One

Introduction to the Artifact Analyses

Frances Joan Mathien

Background

To improve management and interpretation of Chaco Canyon National Monument (now Chaco Culture National Historical Park) and to increase knowledge about the environment and its effects on cultural adaptations in the Chaco drainage of northwestern New Mexico (Figure 1.1), a multidisciplinary research project was initiated in 1969 by the National Park Service, in cooperation with the University of New Mexico (Maruca 1982). Fieldwork began in 1971 with a sample transect survey, followed by a complete survey of the monument (Hayes et al. 1981), plus tests and excavations at numerous sites between 1973 and 1979 (McKenna and Truell 1986; Windes 1987:10-12). Additional ancillary studies were carried out by associates at other institutions. With the enlargement of the monument and change of status to a park in 1980, a survey of the new lands was undertaken; project staff also participated in other cultural resource management projects in the park (e.g., excavations at Una Vida [29SJ 391], Kin Nahasbas [29SJ 392], and 29SJ 626). All these activities provided data that could be used to address numerous research questions.

For any project, the potential questions are many; those addressed must fit the personnel, time, and funds available. The Chaco Project was no exception to this fate (Maruca 1982:29-31). Multidisciplinary research goals were outlined in the Chaco Prospectus (Bradley and Logan 1969); management and interpretive needs were to be served through a combination of studies of culture processes and the environment. The major foci for culture processes were change through time and cultural stability. The relationships between man and the environment would focus on available resources—mineral, floral, faunal, water, soil, and climate. To determine man's relationships with other men, such topics as culture contact, demography, and social organization would be addressed. As sites were being excavated, field observations, preliminary analyses, and new discoveries contributed to changes in these goals. As a result, some aspects of the original research plan received more attention than others. Earlier Archaic and later Navajo occupations of the canyon were studied but most emphasis was placed on the prehistoric populations that inhabited the canyon from ca. A.D. 500 to 1250, the time span that covers the sedentary occupation by people who adopted an agricultural subsistence strategy. During this period, populations grew and fluctuated, and social organization changed, as witnessed by the archeological evidence known as the Chaco Phenomenon (A.D. 900 to 1150) (Judge 1979, 1989).

The Chaco Phenomenon has fascinated researchers for over a century. Archeological investigations in Chaco Canyon began in the 1890s and have continued intermittently thereafter (Lister and Lister 1981). Much of the material from early excavations remained unanalyzed and unpublished; some of it had been lost. The origins, development, manifestations, and demise of the Chaco Phenomenon continue to be topics of research addressed by many investigators, not just those connected with the Chaco Project (e.g., Doyel 1992; Irwin-Williams and Shelley 1980; Kintigh 1994; Sebastian 1992; Vivian 1990; and Wilcox 1993). These investigators bring different theoretical concepts to their research and provide alternative interpretations for data gathered in the field. Over the years, the Chaco Project investigators have also reviewed their perspectives as new data and interpretations became available (Crown and Judge 1991). The papers in this volume, however, reflect a set of ideas dominant during a

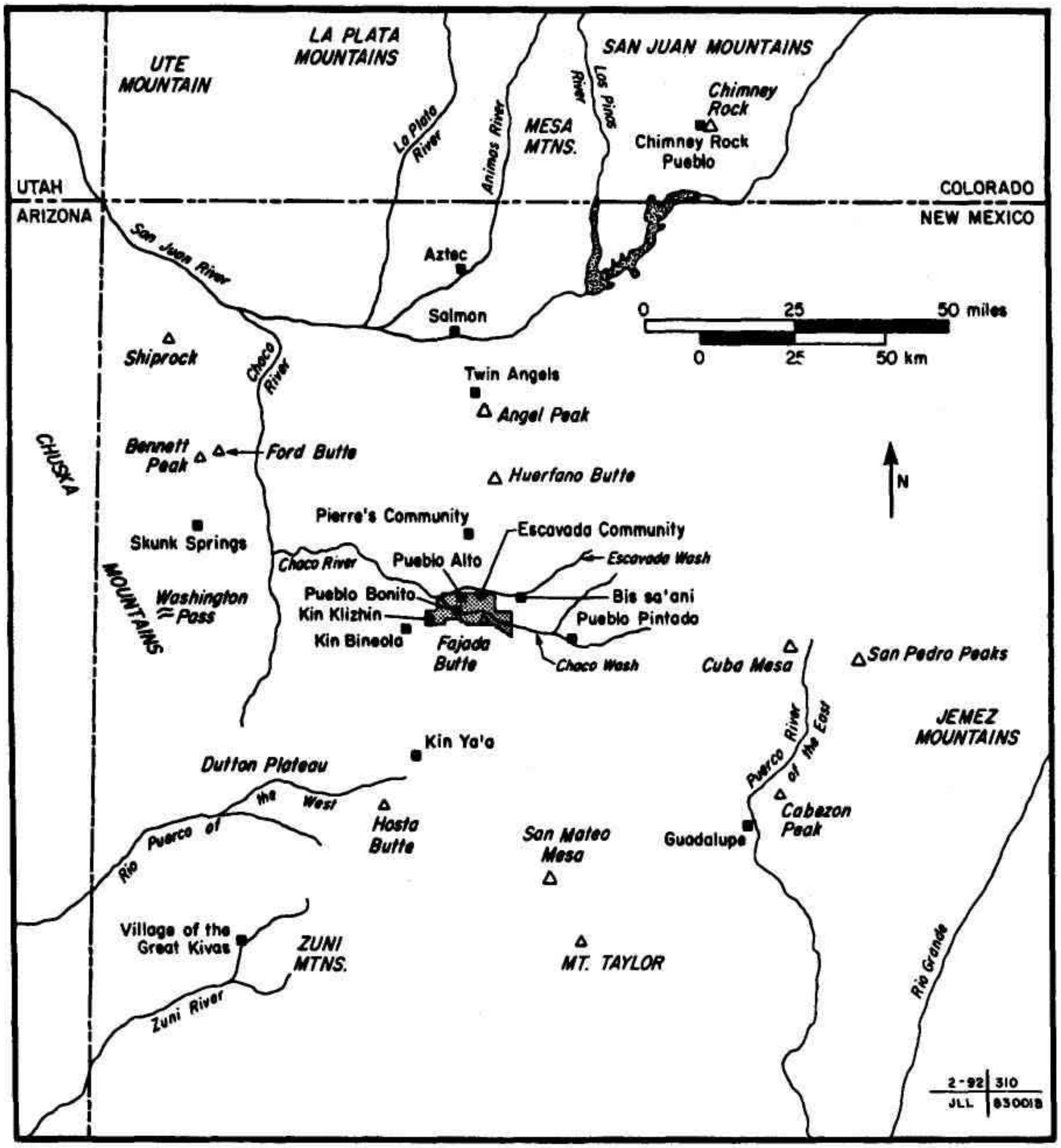

Figure 1.1. *Northwestern New Mexico showing location of Chaco Canyon within the San Juan Basin. (NPS Chaco Archive Negative No. 83001B).*

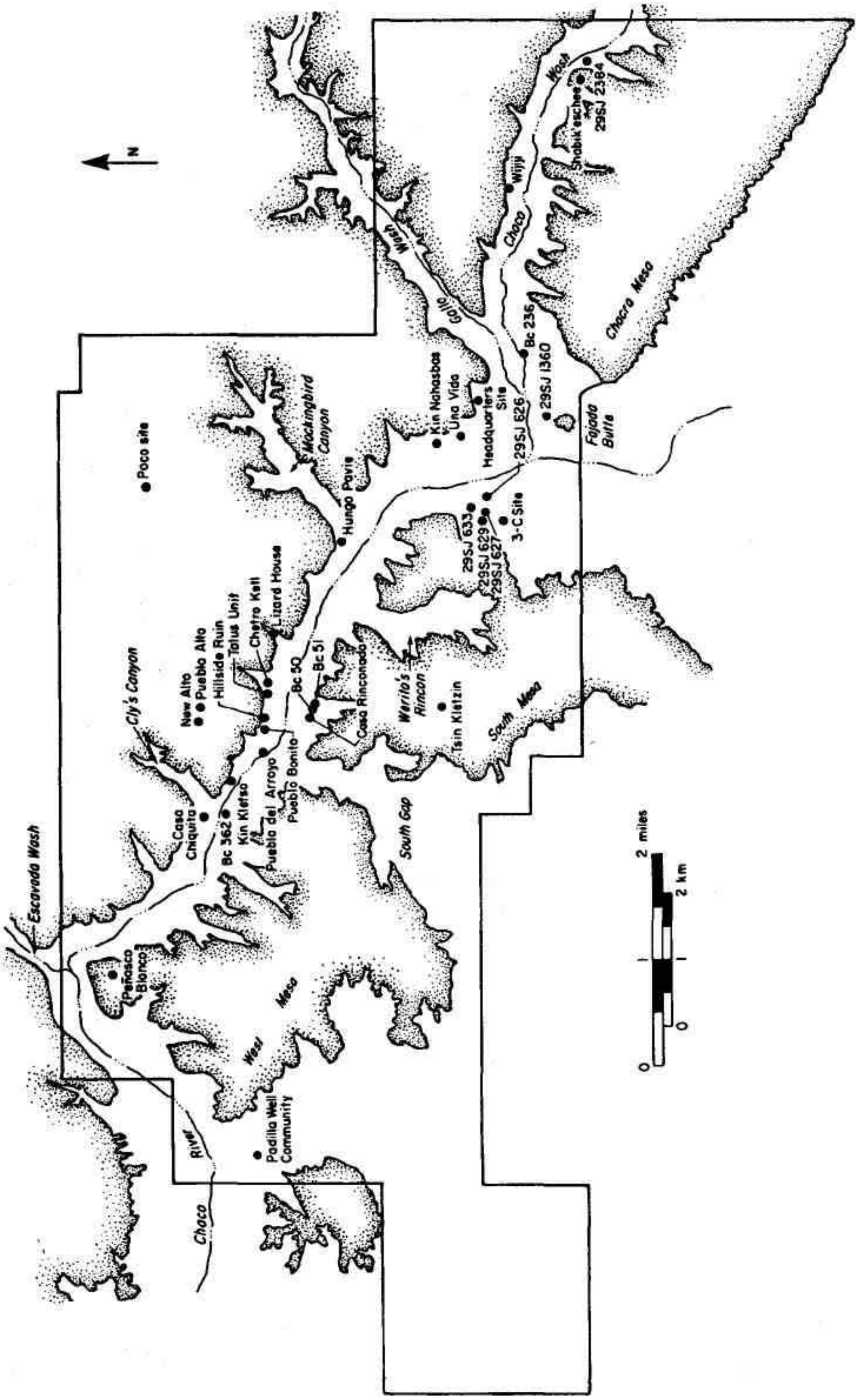

Figure 1.2. Major sites excavated during the NPS Chaco Project. (NPS Chaco Archive Negative No. 83000B.)

particular period of research—the late 1970s—when chronological studies of change through time were replaced by an explanation of Chaco as a central place in a larger redistribution system (Judge 1979).

The constant increases in comparative data available from studies that have been carried out as part of other projects, instituted either simultaneously with or subsequent to the Chaco Project, resulted in a large database for the Chaco Phenomenon. If comparative data from other studies conducted in Chaco Canyon, the San Juan Basin (e.g., the Salmon Ruin, Irwin-Williams and Shelley 1980), or the Southwest are added, the amount of time and energy invested in an analysis increases exponentially. As a result, the chapters in this volume vary in the amount of data analyzed due to personnel constraints and the amount of time individuals had to complete their work. Thus, the analytical reports, while providing new insights about the inhabitants of the area, particularly with regard to change through time, trade networks, and social stratification, are neither all inclusive nor comparable. Much data remains to be evaluated.

For the Chaco Project, McKenna (1986:11) indicates that approximately 45 sites were investigated; his count included 20 stone circles from 13 different sites. Four sites were excavated prior to backfilling or road expansion projects (Table 1.1). The analyses included in this volume use data mainly from ten to twelve small-house sites and one greathouse, Pueblo Alto (29SJ 389) (Figure 1.2), that spanned the period under consideration. Depending on when studies were carried out and the type of employment appointment of the analyst, however, the authors included data from varying numbers of sites. Table 1.2 demonstrates how uneven the inclusion of material from various sites was.

To obtain insight into material that had to be analyzed, an ongoing computerized database was maintained by provenience and material type, as well as other basic variables. When designing their analyses, the investigators used this database to assess the number of items and the variability for a particular artifact type in the archeological record through time. Combined with then current concepts and functional explanations for a type, analysts were able to determine what questions could best be answered. In some instances, e.g., abraders, a major consideration was the selection of variables recorded to refine an understanding of how these objects were classified and used. In many instances, the large number of artifacts necessitated the use of a sampling strategy, e.g., ceramics. To assess the usefulness of recording forms and the database to provide answers to research questions, preliminary studies used samples from several sites. These studies were done prior to the conclusion of all the Chaco Project excavations (e.g., Pueblo Alto [29SJ 389] and the Eleventh Hour Site [29SJ 633]), and though most of these early studies were documented, final analyses were not always undertaken.

Personnel also changed over time. None of the contributors to this volume were employed by the National Park Service from the inception of the Chaco Project through its completion. Most were hired as temporary appointments (Maruca 1982), a few were students who were pursuing undergraduate and graduate degrees at several different institutions, and some joined the staff after the fieldwork was completed, but the artifact analyses were still underway. For this reason, the contributions herein were prepared at various times. Table 1.3 indicates when these reports were written and, in some cases, updated. Unfortunately, not all authors had the same opportunities to revise their work; most of the archeologists who were on temporary appointments are now employed full-time on other projects or by other institutions and were unable to take on the additional burdens of major revisions. As a result, updates are sometimes minimal or more recent evaluations by these investigators are published elsewhere. Although I regret several gaps in this volume, the philosophy under which I am working is that it is better to publish what we have than never to publish at all.

In addition to the above constraints, chronological placement of sites and cultural material has been updated by more recent investigations and evaluations. At the time the chapters in this volume were written, we recognized the need for a chronological framework that would allow comparison of sites in both a synchronic and diachronic manner. Using the available absolute dates and ceramic data, a time-space matrix was devised (see Cameron, Chapter 3, for more detail) and periods were divided into major segments to better handle data needed to prepare the overview summaries. Table 1.4 indicates the major subdivisions of the Bonito Phase and their associated

Table 1.1. Sites tested and excavated during the NPS Chaco Project or by Chaco Project personnel and other cultural resources managers.[a]

Site Number/ Name(s)	Chronological Placement	Excavator(s)	Published References	Comments
29SJ 116	Archaic	Thomas W. Mathews		Field notes
29SJ 126	Archaic	Dennis Stanford Thomas Lyons		Field notes
29SJ 299	Basketmaker III Pueblo I Pueblo II	Richard Loose Thomas C. Windes and Kelley Masterson		Ms. by Loose (1978); Windes (1976a)
29SJ 389 (Pueblo Alto)	Pueblo II-III	Thomas C. Windes	Windes (1987)	
29SJ 390 (Rabbit Ruin)	Pueblo III		Windes (1987)	Walls cleared
29SJ 423	Basketmaker III Pueblo III	Thomas C. Windes	Hayes and Windes (1974)	Ms. by Windes (1975a)
29SJ 625 (Three C Site)	Pueblo II	Thomas C. Windes Earl Neller		Test only; field notes
29SJ 626 West	Pueblo I-Early Pueblo II	Thomas C. Windes		Test only by Chaco Project; later CRM; field notes
29SJ 627	Pueblo I-Early Pueblo III	Marcia L. Truell	Truell (1992)	
29SJ 628	Basketmaker III-Pueblo I	Marcia L. Truell		Ms. by Truell (1976)
29SJ 629 (Spadefoot Toad Site)	Pueblo I-Early Pueblo II Early Pueblo III	Thomas C. Windes	Windes (1993)	
29SJ 630	Pueblo II-Early Pueblo III	Earl Neller Robert P. Powers		Test only; field notes
29SJ 633 (Eleventh Hour Site)	Pueblo II Pueblo III	Marcia L. Truell LouAnn Jacobson	Mathien (1991)	
29SJ 721	Basketmaker III-Pueblo I Early Pueblo III	Thomas C. Windes		Ms. by Windes (1975b)
29SJ 724	Pueblo I	Thomas C. Windes		Ms. by Windes (1976b)
29SJ 1010 (Poco Site)	Pueblo III	Dwight L. Drager Thomas Lyons		Ms. by Drager and Lyons (1983)

Table 1.1. (continued)

Site Number/ Name(s)	Chronological Placement	Excavator(s)	Published References	Comments
29SJ 1088	Pueblo III	Thomas C. Windes Peter J. McKenna		Ms.
29SJ 1156 (Atlatl Cave)	Archaic	Thomas Mathews	Mathews and Neller (1979)	Ms. by Neller (1975, 1976a)
29SJ 1157 (Sleeping Dune)	Archaic	Earl Neller		Ms. by Neller (1976b)
29SJ 1360	Pueblo I-Early Pueblo II	C. Randall Morrison Peter J. McKenna	McKenna (1984)	
29SJ 1579				Field notes
29SJ 1659 (Shabik'eshchee Village)	Basketmaker III-Pueblo I	Alden C. Hayes, James Thrift	Roberts (1929)	Ms. by Hayes (1975)
29SJ 1613 (The Doll House Site)	Navajo	David M. Brugge	Brugge (1986)	
29SJ 1987	Archaic	John D. Schelberg Kelley Masterson		Field notes
29Mc184	Pueblo I	Thomas C. Windes		Field notes, Ms. by Windes
OTHER CRM EXCAVATIONS[b]				
29SJ 391 (Una Vida)	Pueblo II Pueblo III Navajo reuse	Nancy J. Akins William B. Gillespie	Gillespie (1984)	Akins and Gillespie (1979)
29SJ 392 (Kin Nahasbas)	Pueblo II Pueblo III	Thomas C. Windes F. Joan Mathien	Mathien and Windes (1988)	Luhrs (1935)
29SJ 597	Pueblo II	Thomas C. Windes James Trott James Bradford Bruce Anderson (1979-81)		Field notes
29SJ 626 East	Pueblo I-Early Pueblo II	James Bradford Peter J. McKenna Judith Miles (1983) Thomas C. Windes		Field notes

[a] Taken from Truell (1986:Table 2.1) and supplemented. Does not include stone circles (Windes 1978); 13 sites (20 stone circles) discussed in that volume include: 29SJ 692 N, 29SJ 692 S, 29SJ 866, 29SJ 919, 29SJ 1326, 29SJ 1419, 29SJ 1474, 29SJ 1505 E, 29SJ 1505 W, 29SJ 1533, 29SJ 1565, 29SJ 1592, 29SJ 1660, 29SJ 1976 A, 29SJ 1976 B, 29SJ 1976 C, 29SJ 1976 D, 29SJ 1976 E, 29SJ 1976 F, 29SJ 2240.

[b] Data on file in National Park Service Chaco Archive, University of New Mexico, Albuquerque, or National Park Service, Santa Fe.

Table 1.2. Sites analyzed in the following chapters.

	Chapter								
Site Number (Name)	2 Toll Ceramics	3 Cameron Chipped Stone	4 Lekson Chipped Stone Tools	5 Akins Abraders	6 Wills Hammer-stones	7 Breternitz Axes and Mauls	8 Cameron Manos	9 Schelberg Metates	10 Mathien Ornaments
29MC 184	-	x	-	-	-	-	-	-	A
29SJ 299	x	x	x	x	x	-	x	x	x
29SJ 389 (Pueblo Alto)	x	x	x	x	x	x	x	x	x
29SJ 390 (Rabbit Ruin)	-	-	-	x	-	x	-	x	N
29SJ 391 (Una Vida)	-	x	x	x	-	x	x	x	x
29SJ 423	x	x	x	x	x	-	x	x	x
29SJ 589 (Bc 236)	-	-	-	-	-	-	-	C	-
29SJ 597	-	-	-	-	-	-	-	-	A
29SJ 626	A	x	-	-	-	-	-	-	A
29SJ 627	x	x	x	x	S	x	S	x	x
29SJ 628	x	x	x	x	x	x	x	x	x
29SJ 629 (Spadefoot Toad Site)	x	x	x	x	x	x	x	x	x
29SJ 630		x	x	x	-	-	-	-	x
29SJ 633 (Eleventh Hour Site)	x	x	x	x	-	-	-	x	x
29SJ 721	x	x	x	-	x	x	x	-	x
29SJ 724	x	x	x	x	x	x	x	x	x

Table 1.2. (continued)

	Chapter								
	2	3	4	5	6	7	8	9	10
Site Number (Name)	Toll Ceramics	Cameron Chipped Stone	Lekson Chipped Stone Tools	Akins Abraders	Wills Hammerstones	Breternitz Axes and Mauls	Cameron Manos	Schelberg Metates	Mathien Ornaments
29SJ 750 (Leyit Kin)	-	-	-	-	-	-	-	C	C
29SJ 753 (Bc 56)	-	-	-	-	-	-	-	C	C
29SJ 827 (Bc 362)	-	-	-	-	-	-	-	C	C
29SJ 838 (Bc 126)	-	-	-	-	-	-	-	C	C
29SJ 1156 (Atlatl Cave)	-	-	-	-	-	-	-	-	x
29SJ 1157 (Sleeping Dune)	-	-	-	-	-	-	-	-	x
29SJ 1360	x	x	x	x	x	x	x	x	x
29SJ 1613 (Doll House Site)	-	-	-	-	-	-	-	-	x
29SJ 1659 (Shabik'eshchee Village)	x	x	x	x	-	C	x	x	x
29SJ 1947 (Pueblo del Arroyo	-	C	-	-	-	-	-	-	C
Compared With	Literature	-	Material from Chaco surveys, excavations and literature.	Literature search	Literature search	Literature search	Bc 236 29SJ 288 Chetro Ketl	Literature search	Literature search

N = no artifacts of this nature.
A = analyzed, but not included in this report.
C = comparative data from old reports used, but new artifacts not included.
S = sampled only.
x = included in report.

Table 1.3. Chronology of chapters included in this volume.

Chapter	Title and Author(s)	Year Prepared	Year Updated
1	Introduction by F. J. Mathien	1993	1995
2	Chaco Project Ceramics Overview by H. W. Toll	1986	1995
3	The Chipped Stone of Chaco Canyon, New Mexico, by C. M. Cameron	1982	1995
4	Points, Knives, and Drills of Chaco Canyon by S. H. Lekson	1980	1985
5	The Abraders of Chaco Canyon: An Analysis of their Form and Function by N. J. Akins	1980	No
6	A Preliminary Analysis of Hammerstones from Chaco Canyon, New Mexico, by W. H. Wills	1977	No
7	An Analysis of Axes and Mauls from Chaco Canyon, New Mexico, by C. D. Breternitz	1976	No
8	An Analysis of Manos from Chaco Canyon, New Mexico, by C. M. Cameron	1985	No
9	Metates by John D. Schelberg	1982	1995
10	Ornaments of the Chaco Anasazi by F. J. Mathien	1985	1992
11	Summary and Conclusions by F. J. Mathien	1993	1995

ceramic assemblages; these major periods were used by the analysts in this volume. Because continuing study leads to revisions in chronology, Table 1.5 correlates these periods with updated time frames revised by T. C. Windes, a member of the permanent NPS staff, who continues to work with Chaco Project data. In many instances, authors used Basketmaker III, Pueblo I, Pueblo II, and Pueblo III in their site reports (e.g., Truell for 29SJ 627 [1992]; Windes for 29SJ 629 [1993] and Pueblo Alto [1987]).

With continuing research on lithic materials, our knowledge of obsidian sources has improved. In his recent report on 29SJ 629, Windes (1993:304-307) indicates that the percentages of obsidian originally identified as coming from a source near Red Hill, New Mexico, (Cameron and Sappington 1984) may have been overstated. In a recent re-examination of obsidian from site 29SJ 629, some of that material was assigned to sources near Mt. Taylor. As a result, Windes concludes that the Grants area sources were used more and the Red Hill source used less than previously believed. This new information does not change the inference that obsidian was an import into Chaco Canyon at all times, but it does affect the direction from which materials were carried and the distances involved, which, in turn, affects the interpretations of social organization.

The chapters in this volume do not present a comprehensive picture of the prehistoric Chaco adaptation. To supplement the analyses presented in this volume, readers are encouraged to examine other data sets, in addition to the preliminary results published previously (Judge and Schelberg 1984; Noble 1984), or those pertaining to the environment and subsistence of Chaco Canyon (Mathien 1985). Both small site and great pueblo architecture have been examined (Lekson 1984; McKenna and Truell 1986), in addition to other Chaco communities in the San Juan Basin, by several investigations (Fowler et al. 1987; Marshall et al. 1979; Powers et al. 1983). The Bureau of Land Management continued major investigations of the Chaco roads located outside of the canyon (Kincaid 1983; Nials et al. 1987). These volumes, among others, should be considered part of the broader database from which conclusions about the Chaco Anasazi system can be drawn.

This Volume

This volume has been organized into sections, with groups of papers combined, based on material types.

1) The first section consists of the analysis of ceramics, the most abundant material recovered. H. Wolcott Toll outlines the overall goals of the ceramic studies in Chapter Two. The goals are to place the material from Chaco Canyon in a regional

Table 1.4. Bonito Phase ceramic assemblages in Chaco Canyon: A.D. 900-1140.[a]

Phase	Whiteware	Redware	Culinary
Early Bonito Phase A.D. 900-975± (early Red Mesa)	Red Mesa B/w Whitemound B/w Tunicha B/w Kana'a B/w LaPlata B/w	San Juan Redwares (types unidentified) Deadman's B/r LaPlata B/r Bluff B/o Sanostee B/r	Cibola/Tusayan Plain Gray Cibola Narrow Neckbanded Tohatchi Banded Kana'a Neckbanded Cibola Neck Indented Corrugated Chuskan Neck Indented Corrugated Lino Gray
Early Bonito Phase A.D. 975±1040/1050 (Red Mesa)	Red Mesa B/w Escavada B/w Newcomb B/w Burnham B/w	San Juan Redwares (types unidentified) LaPlata B/r Deadman's B/r	Cibola/Tusayan Plain Gray Cibola Narrow Neckbanded Cibola Neck Indented Corrugated Chuskan Neck Indented Corrugated Chuskan Narrow Neckbanded Tohatchi Banded
Classic Bonito Phase A.D. 1040/1050-1100 (Gallup)	Gallup B/w Puerco B/w Red Mesa B/w Chuska B/w Toadlena B/w Black Mesa B/w Mancos B/w	Tsegi Orangewares (types unidentified) San Juan Redwares Tusayan B/r	Cibola Corrugated (unidentified) Chuskan Corrugated (unidentified) Indented Corrugateds (types unidentified) Exuberant Corrugated Coolidge Corrugated Blue Shale Corrugated Tohatchi Banded
Late Bonito Phase A.D. 1100-1140 (Late Mix)	Chaco-McElmo B/w Gallup B/w Puerco B/w McElmo B/w Chuska B/w Toadlena B/w Black Mesa B/w Mancos B/w Sosi B/w Socorro B/w	White Mountain Redwares (types unidentified) Tsegi Orangewares (B/r and polychromes) Puerco B/r Wingate B/r Wingate Polychrome	Chuskan Corrugated (unidentified) Cibola Corrugated (unidentified) Indented Corrugateds (types unidentified) Coolidge Corrugated Blue Shale Corrugated Chaco Corrugated Hunter Corrugated Mancos? Corrugated

[a] Types arranged in approximate descending order of frequency. Not all minority types listed. Table taken from Windes (1987a:246, Table 8.15).

Table 1.5. Ceramic typological time in Chaco Canyon.[a]

Ceramic Spans for Artifact Analyses	Ceramic Spans Revised	Phase/Ceramic Period	Dominant Painted Ceramic Type(s)
A.D. 900-1020	A.D. 900-1040/1050	Early Bonito Phase A.D. 900-975± (early Red Mesa) Early Bonito Phase A.D. 975±-1040/1050 (Red Mesa)	Red Mesa Black-on-white Red Mesa Black-on-white
A.D. 1020-1040	A.D. 1040/1050		Red Mesa Black-on-white and Gallup Black-on-white
A.D. 1020-1120	A.D. 1040/1050-1100	Classic Bonito Phase (Gallup)	Gallup Black-on-white
A.D. 1120-1220	A.D. 1100-1140	Late Bonito Phase (Late Mix)	Gallup Black-on-white Puerco Black-on-white Chaco-McElmo Black-on-white McElmo Black-on-white (local varieties)

[a] Taken from Windes (1987b[III]:8, Table I.2).

perspective by identifying not only the ceramic sources used throughout the San Juan Basin, but also the temper sources used by potters whose vessels became part of the Chaco Project excavations. Toll presents data on temper, paste, and clay samples prior to evaluating ceramic importation from the San Juan Basin and outlying areas, in addition to providing ceramic production data at sites within the canyon.

2) The second section includes two complementary analyses of chipped stone. In Chapter Three, Catherine M. Cameron uses data from 16 sites to address several questions that pertain to two general topics: the development and adaptation of the Chaco inhabitants through time, and the role of Chaco Canyon as a central place. She contrasts the use of exotic and local material types (exotics determined by a source distance of over 10 km) in several ways, including technology and tool function.

In Chapter Four, Stephen H. Lekson summarizes his earlier (1980) analysis of chipped stone tools and makes two points, based on comparison of sites excavated by the Chaco Project, earlier excavations in Chaco Canyon, and other available data from the American Southwest. Chipped stone tools found in Chaco Canyon are not unusual; what is unusual, however, are the contexts in which some groups of arrow points and blades are found, as well as the materials and workmanship of these items.

These two chapters on chipped stone artifacts refer to several appendices by Bruce Bradley, Catherine Cameron, David Love and Helene Warren, which provide more detailed technological and geological information about material sources and type descriptions.

3) Five papers make up the third section on ground stone. Several were written prior to completion of excavations; they are included because they provide data and relevant conclusions about sources of material and changes in artifact types through time.

In Chapter Five, Nancy J. Akins states that her goals were twofold. First, she wanted to determine the different types of abraders by describing the variables that were specific to them. Second, she examined the contexts in which specific types were found to determine which ones were used through time and what changes took place.

In Chapter Six, Wirt H. Wills addressed five major topics pertaining to the technology, sources of materials, and variability among hammerstones in both time and space. This analysis was carried out prior to the completion of excavations at Pueblo Alto (29SJ 389) and the Eleventh Hour Site (29SJ 633). Wills suggests several topics to be addressed in future studies; Windes (1993) has built on Wills' results and provides additional insights for the uses of this tool type.

In Chapter Seven, Cory D. Breternitz evaluates a sample of 25 axes and mauls recovered prior to 1976, again before the completion of excavations at Pueblo Alto (29SJ 389) and the Eleventh Hour Site (29SJ 633). In addition to providing definitions and creating an analysis form, he was able to evaluate the sample against data found in the literature on earlier excavations in Chaco Canyon. Again, Windes (1993) provides more data and synthesis on axes and mauls from Chaco Project excavations.

In Chapter Eight, Catherine M. Cameron examines manos from 12 excavated sites (n = 1,244). Because of excavation techniques, some material from the earliest Chaco Project site collections were not available. A number of variables were examined. Her data indicate that there is evidence of a possible change in the grinding stroke, which may be associated with the post A.D. 920 development of mealing bins or communal grinding structures.

In Chapter Nine, John D. Schelberg's major concern is with the transition from basin to trough to slab metates and what it means for the prehistoric pueblo people. The concepts of multiple functions, extensive reuse, and energy investment are addressed. The most intriguing discussion, however, relates to the change from flint to flour corn and its reflection in the archeological record.

4) The fourth section addresses ornaments. In Chapter Ten, Mathien considers questions about the materials used, their sources, the personnel and technology involved in jewelry-making, and makes inferences about social organization, based on her analysis of ornaments and minerals.

5) The last section, Chapter Eleven, attempts to tie the results of the analyses presented in this volume together in a preliminary manner; a forthcoming synthesis of the Chaco Project will comment further on the significance of the Chaco Phenomenon and its place in the prehistory of the American Southwest.

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Chapter Two

Chaco Ceramics

H. Wolcott Toll and Peter J. McKenna

Introduction

The Chaco Project went on for many years, worked at many sites, employed a series of people, and collected a lot of pottery. Numerous volumes have been written on the phenomenal information potential of pottery, and all of the people who worked on the Chaco ceramics were very conscious of the endless possibilities contained in them. The material was analyzed from many perspectives. The Chaco Project reporting strategy was in terms of sites; that is, locations with architecturally defined areas that often changed and were reused over long periods. On this basis, a large number of individual collections have been studied and discussed in varying, often (according to some reviewers) excruciating, detail. Because of the range of information available (and imaginable), any report is a compromise. With the probable exception of Al Hayes—who knows better than to waste energy fretting—those of us who worked on these projects were (we would say excruciatingly) concerned about those compromises. This report is designed as an overview, primarily taking a time- and artifact- rather than site-based perspective. Its objectives are several: 1) to provide definitions of types and other attributes recorded by the project. Verbal definitions are complemented by data on occurrence of attributes within types; 2) to present some temporal trends in Chaco ceramics; 3) to use this impressive body of material to attempt to understand aspects of Chaco interactions; and 4) to delve into questions of ceramic production in the Chaco system.

In the anthropological tradition, this document is participant observation. The majority of the text was written by Wolky Toll, and when the first person singular is used, it refers to him. Tom Windes was around the longest; Peter McKenna put in the most time, knew the sherds best and produced many of the numerous tables included here; Al Hayes was the most direct and had the deepest experience; and Helene Warren knew the geology as none of the rest of us did. These are the Chaco ceramics informants—the natives. Compared especially to McKenna and Windes, I came late, left early, and came back temporarily. I came in to learn the culture, and to see how the analysis was done. I invented parts of it, but much was well-established when I arrived. It falls to me, however, to provide the written record, and it is my interpretation, with some correction from the informants, that appears here.

Portions of this were written for my dissertation (Toll 1985) and modified; portions were written to cover the paste analysis in 1986; and portions were written to fill in missing pieces from 1994 to 1996. The analysis on which it is based was performed mostly from 1977 to 1983.

Chaco Project Ceramic Samples

Chaco Project excavations collected 245,107 "potsherds" from 12 sites (Table 2.1). Such a count is strange because a large, complete olla standing nearly half a meter tall counts the same as a 2-cm-by-2-cm fragment of a vessel. The tally also excludes sherds from the survey or from other ancillary work done in Chaco during the span of the project, including two excavations conducted in connection to road work.

Archeology is a baroque sampling exercise from the outset. Understanding, or even beginning to understand what samples are in a ceramic analysis is extremely complex. The ceramics recovered from Chaco Project excavations and the groupings by which they were analyzed are samples at many levels:

Table 2.1. ***Bulk counts by rough sort type for all sites in the Chaco Project analysis.***

	Early Sites							Late Sites							
	Site Numbers (29SJ—)														
Ware	**299-BMIII**	**423**	**1659**	**628**	**299-PI**	**724**	**721**	**629**	**1360**	**627**	**633**	**389**	**Total**	**% N**	**% Ware**
Plain Gray	1,528	1,007	538	4,254	536	2,170	409	11,896	3,394	17,968	843	4,488	49,031	20.0	34.5
Lino Gray	64	168	65	441	36	209	29	104	50	255	5	2	1,428	0.6	1.0
Lino Fugitive	381	12	43	652	21	108	13	41	38	115	8	2	1,434	0.6	1.0
Obelisk Gray	238	497	93	93	6	1	38	20	-	26	-	1	1,013	0.4	0.7
Wide Neckbanded	5	-	-	21	4	3	2	685	238	237	35	247	1,477	0.6	1.0
Narrow Neckbanded	59	-	-	75	16	4	-	3,187	1,370	5,590	207	3,021	13,529	5.5	9.5
Neck Corrugated	20	-	-	-	7	-	7	216	225	698	21	254	1,448	0.6	1.0
PII Corrugated	50	-	-	59	9	-	-	141	44	811	37	627	1,778	0.7	1.3
PII-PIII Corrugated	63	3	-	98	-	-	-	7	-	180	9	279	639	0.3	0.5
PIII Corrugated	1	-	-	-	1	-	-	3	-	40	16	102	163	0.1	0.1
Unident. Corrugated	78	1	-	25	53	11	20	4,061	718	22,687	3,599	38,961	70,214	28.7	49.4
TOTAL GRAY	2,487	1,688	739	5,718	689	2,506	518	20,361	6,077	48,607	4,780	47,904	142,154	58.0	100.0
BMIII-PI Polished M/w	34	19	19	35	10	3	7	191	159*	151	21*	5	654	0.3	0.7
BMIII-PI Unpolished M/w	53	23	2	262	16	206	35	101	-	242	-	12	952	0.4	1.0
Early Red Mesa B/w	7	-	-	16	17	-	1	1,094	271	758	18	177	2,359	1.0	2.4
Red Mesa B/w	113	-	-	148	39	11	4	3,449	2,291	7,527	155	2,902	16,639	6.8	17.0
Escavada B/w	-	-	-	-	2	-	-	11	71+	368	27	646	1,125	0.5	1.1
Puerco B/w	2	-	-	5	10	-	-	36	-	1,154	41	1,736	2,984	1.2	3.0
Gallup B/w	12	-	-	40	61	3	8	256	108	3,932	242	8,595	13,259	5.4	13.5
Chaco B/w	-	-	-	1	-	-	1	19	5	178	21	258	483	0.2	0.5
Exotic M/w	-	-	-	3	2	-	-	7	86	157	38	323	616	0.3	0.6
PII-PIII M/w	88	1	-	98	49	-	6	2,342	1,816	6,999	861	10,630	22,890	9.3	23.3
TOTAL MINERAL-ON-WHITE	309	43	21	608	206	223	62	7,506	4,807	21,466	1,424	25,284	61,959	25.3	63.1

* Combined polished and unpolished figures.

\+ Puerco-Escavada figure.

Table 2.1. (continued)

Ware	Early Sites							Late Sites							
	Site Numbers (29SJ----)														
	299-BMIII	423	1659	628	299-PI	724	721	629	1360	627	633	389	Total	% N	% Ware
BMIII-PI Polished C/w	4	-	-	24	2	3	-	191	5	135	6	37	407	0.2	0.4
BMIII-PI Unpolished C/w	3	2	1	130	1	13	-	13	26	58	2	3	252	0.1	0.3
PII-III C/w	18	1	-	13	5	1	4	149	1	1,112	249	1,646	3,216	1.3	3.3
Mesa Verde B/w	5	-	-	-	-	-	-	2	1	-	144	7	159	0.1	0.2
Chaco McElmo B/w	1	-	-	-	-	-	-	-	6	-	9	804	820	0.3	0.8
Chuska B/w	-	-	-	-	-	-	-	-	3	-	3	560	566	0.2	0.6
Chuska Whiteware	2	-	-	-	-	-	-	-	32	1	24	1,087	1,146	0.5	1.2
Red Mesa design Chuska	3	-	-	-	-	-	-	-	59	-	2	249	313	0.1	0.3
Tusayan Whiteware	-	-	-	-	-	-	-	-	3	3	7	410	420	0.2	0.4
TOTAL CARBON-ON-WHITE	36	3	1	167	8	17	4	355	153	1,306	446	4,803	7,299	3.0	7.4
Unident. Whiteware	146	7	1	236	85	39	10	4,315	1,633	12,083	824	9,507	28,886	11.8	29.4
TOTAL WHITEWARE	491	53	23	1,011	299	279	76	12,176	6,593	34,855	2,694	39,594	98,144	40.1	100.0
Plain Red	-	84	1	30	-	2	-	-	-	1	35	42	195	0.1	8.1
Decorated Red	8	4	-	7	7	37	1	181	63	574	130	1,171	2,183	0.9	90.5
Polychrome	-	-	-	-	-	-	-	-	-	-	18	16	34	0.0	1.4
TOTAL REDWARE	8	88	1	37	7	39	1	181	63	575	183	1,229	2,412	1.0	100.0
Polished Smudged	8	5	13	118	1	45	12	96	59	432	18	1,319	2,126	0.9	100.0
Brownware	-	44	-	-	-	-	-	-	-	4	11	9	68	0.0	100.0
Mudware	103	-	1	5	-	-	-	-	-	-	-	4	113	0.0	100.0
GRAND TOTAL	3,097	1,878	777	6,889	996	2,869*	607	32,814	12,792	84,473	7,686	90,139	245,017	100.0	-

* Does not count two Navajo sherds from 29SJ 724.

Table 2.2. Percentages of rough sort type bulk counts found at each Chaco Project site (counts listed in Table 2.1).

	Early Sites							Late Sites				
	Site Numbers (29SJ---)											
Ware	299-BMIII	423	1659	628	299-PI	724	721	629	1360	627	633	389
Plain Gray	3.1	2.1	1.1	8.7	1.1	4.4	0.8	24.3	6.9	36.6	1.7	9.2
Lino Gray	4.4	11.8	4.6	30.9	2.5	14.6	2.0	7.3	3.5	17.9	0.4	0.1
Lino Fugitive	26.6	0.8	3.0	45.5	1.5	7.5	0.9	2.9	2.6	8.0	0.6	0.1
Obelisk Gray	23.5	49.1	9.2	9.2	0.6	0.1	3.7	2.0	-	2.6	-	0.1
Wide Neckbanded	0.3	-	-	1.4	0.3	0.2	0.1	46.4	16.1	16.1	2.4	16.7
Narrow Neckbanded	0.4	-	-	0.6	0.1	-	-	23.6	10.1	41.3	1.5	22.3
Neck Corrugated	1.4	-	-	-	0.5	-	0.5	14.9	15.5	48.2	1.5	17.5
PII Corrugated	2.8	-	-	3.3	0.5	-	-	7.9	2.5	45.6	2.1	35.3
PII-PIII Corrugated	9.8	0.5	-	15.3	-	-	-	1.1	-	28.2	1.4	43.7
PIII Corrugated	0.6	-	-	-	0.6	-	-	1.8	-	24.5	9.8	62.6
Unident. Corrugated	0.1	-	-	-	0.1	-	-	5.8	1.0	32.2	5.1	55.5
GRAYWARE												
% Column	80.3	89.9	95.1	83.0	69.2	87.3	85.3	62.0	47.5	57.5	62.2	53.2
% Row	1.7	1.2	0.5	4.0	0.5	1.8	0.4	14.3	4.3	34.2	3.4	33.7
BMIII-PI Polished	5.2	2.9	2.9	5.4	1.5	0.5	1.1	29.2	24.3	23.1	3.2	0.8
BMIII-PI Unpolished	5.6	2.4	0.2	27.5	1.7	21.6	3.7	10.6	-	25.4	-	1.3
Early Red Mesa	0.3	-	-	0.7	0.7	-	-	46.4	11.5	32.1	0.8	7.5
Red Mesa	0.7	-	-	0.9	0.2	0.1	-	20.7	13.8	45.2	0.9	17.4
Escavada	-	-	-	-	0.2	-	-	1.0	6.3	32.7	2.4	57.4
Puerco B/w	0.1	-	-	0.2	0.3	-	-	1.2	-	38.9	1.4	58.2
Gallup B/w	0.1	-	-	0.3	0.5	-	0.1	1.9	0.8	29.7	1.8	64.8
Chaco B/w	-	-	-	0.2	-	-	0.2	3.9	1.0	36.9	4.4	53.4
Exotic M/w	-	-	-	0.5	0.3	-	-	1.1	14.0	25.5	6.2	52.5
PII-III M/w	0.4	-	-	0.4	0.2	-	-	10.2	7.9	30.6	3.8	46.4
MINERAL-ON-WHITE												
% Column	10.0	2.3	2.7	8.8	20.7	7.8	10.2	22.9	37.6	25.4	18.5	28.1
% Row	0.5	0.1	-	1.0	0.3	0.4	0.1	12.1	7.8	34.6	2.3	40.8]
BIII-PI Polished C/w	1.0	-	-	5.9	0.5	0.7	-	46.9	1.2	33.2	1.5	9.1
BMIII-PI Unpolished C/w	1.2	0.8	0.4	51.6	0.4	5.2	-	5.2	10.3	23.0	0.8	1.2
PII-III C/w	0.6	-	-	0.4	0.2	-	0.1	4.6	0.6	34.6	7.9	51.2
Mesa Verde B/w	3.1	-	-	-	-	-	-	1.3	0.6	-	90.6	4.4
Chaco McElmo B/w	0.1	-	-	-	-	-	-	-	0.7	-	1.1	98.1
Chuska B/w	-	-	-	-	-	-	-	-	0.5	-	0.5	98.8
Chuska Whiteware	0.2	-	-	-	-	-	-	-	2.8	0.1	2.1	94.8
Red Mesa design Chuska	1.0	-	-	-	-	-	-	-	18.8	-	0.6	79.6
Tusayan Whiteware	-	-	-	-	-	-	-	-	0.7	-	1.7	97.6

Table 2.2. *(continued)*

	Early Sites							Late Sites				
	Site Numbers (29SJ---)											
Ware	299-BMIII	423	1659	628	299-PI	724	721	629	1360	627	633	389
CARBON-ON-WHITE												
% Column	1.2	0.2	0.1	2.4	0.8	5.9	0.7	1.1	1.2	1.5	5.8	5.3
% Row	0.5	-	-	2.3	0.1	0.2	0.1	4.9	2.1	17.9	6.1	65.8
WHITEWARE												
% Column	15.9	2.8	3.0	14.7	30.0	9.7	12.5	37.1	51.5	41.3	35.1	43.9
% Row	0.5	0.1	-	1.0	0.3	0.3	0.1	12.4	6.7	35.5	2.7	40.3
Plain Red	-	43.1	0.5	15.4	-	1.0	-	-	-	0.5	18.0	21.5
Decorated Red	0.4	0.2	-	0.3	0.3	1.7	-	8.3	2.9	26.3	6.0	53.6
Polychrome	-	-	-	-	-	-	-	-	-	-	52.9	47.1
REDWARE												
% Column	0.3	4.7	0.1	0.5	0.7	1.3	0.2	0.6	0.5	0.7	2.4	1.4
% Row	0.3	3.7	-	1.5	0.3	1.6	-	7.5	2.6	23.8	5.4	48.5
Polished Smudged												
% Column	0.3	0.2	1.6	1.7	0.1	1.6	2.0	0.3	0.5	0.5	0.2	1.5
% Row	0.4	0.2	0.6	5.6	0.1	2.1	0.6	4.3	2.8	20.3	0.8	62.0
Brownware												
% Column	-	2.3	-	-	-	-	-	-	-	-	0.1	-
% Row	-	64.7	-	-	-	-	-	-	-	5.9	16.2	13.2
Mudware												
% Column	3.3	-	0.1	0.1	-	-	-	-	-	-	-	-
% Row	91.2	-	0.9	4.4	-	-	-	-	-	-	-	3.5

1) Prehistorically, the people of Chaco drew from the universe of Anasazi vessels, both those they may have made, and those that were available from the macro-region. Although this group is in fact a sample, it is the population about which we want to know.

2) From that population, vessels and, much more often, fragments of vessels entered the depositional record in varying ways, in varying frequencies, and, depending on their forms, functions, and the caprice of fate, at varying rates (see David 1972; Foster 1965). Some unknown number of fragments from this group would have been used for secondary purposes, such as scrapers or pendants; others would have been completely destroyed for use as temper.

3) After a millennium or so of sampling by rodents, erosion, trampling and other destructive forces, unquantifiable portions of the depositional record were collected archeologically, and even that sampling varied in technique over the multiyear course of the project.

4) The group of sherds and vessels collected by the project then went through further sampling procedures. The surface-collected materials from the survey were treated separately from the excavation collections (results reflected in Hayes 1981; McKenna 1981). The entire collection of pottery from excavation, less those discarded as too small or those for which provenience data were lost, constitute the "rough sort" or "bulk sample." Because of the filters through which it has already passed, it includes far less than all parts of all vessels from the sites excavated (Tables 2.1 and 2.2).

5) In spite of its incompleteness, the total collection was far larger than could be analyzed in detail, including surface treatment, design, temper, alterations, measurements, clay, and so forth. Moreover, such an analysis would produce much redundant information since most vessels—the behavioral unit of focal interest—are represented in this sample by multiple sherds.

6) The sample on which most of this report is based is called the "detailed analysis sample" (Table 2.3). Fundamentally, this sample is based on sherds that included some portion of a vessel rim, although its composition was more complicated than analyzing all rim sherds. Any time sherds could be definitively attributed to a single vessel, they were treated as a single specimen. This matching procedure took place in several stages; large numbers of sherds were laid out at a single time and inspected for matches, then possible matches recognized during either surface or temper analysis were checked. Matches across proveniences were made available to site report writers for the information they contain about possible relationships between deposits. Obviously, thousands of existing matches within the bulk collection were not identified, and undoubtedly some were missed within the smaller and more closely scrutinized detailed analysis sample, but on the whole, the vessel control is quite good.

There are problems with a rim-based sample. Not every vessel represented in the bulk sample is represented by a rim sherd (Table 2.4). Some vessels, such as whiteware ollas or canteens, have very small rims relative to their overall size, and often the decoration near the rim bears little relationship to the decoration on the main part of the vessel (Figure 2.1). Some compensation was attempted for this problem by including some large whiteware body sherds with design panels in the

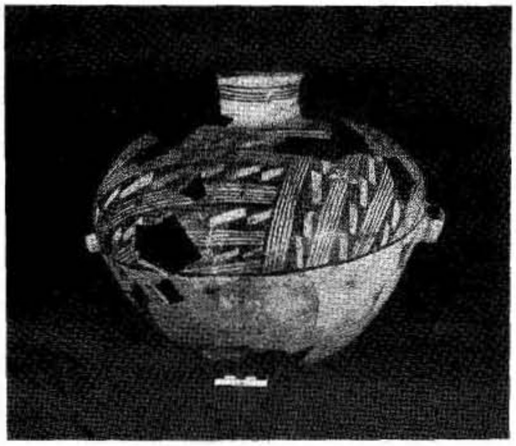


Figure 2.1. Chuskan olla from multiple Pueblo Alto proveniences illustrating the independence of rim decoration from main body decoration often seen in whiteware jars and ollas (NPS Chaco Archive Negative No. 23144).

Table 2.3. Detailed analysis sample composition, showing sherd type occurrence within types.

	Sherd Type								
	Rim Sherd		Worked Rim		Worked Non-Rim		Neither Worked nor Rim		Total
Rough Sort Type	No.	% of Type	No.	% of Type	No.	% of Type	No.	% of Type	No.
Plain Gray	111	14.5	2	0.3	43	5.6	610	79.6	766
Lino Gray	603	92.3	1	0.2	2	0.3	47	7.2	653
Lino Fugitive Red	55	26.7	2	1.0	3	1.5	146	70.9	206
Polished Tan Gray	83	15.4	1	0.2	5	0.9	449	83.5	538
Wide Neckbanded	249	83.3	-	-	3	1.0	47	15.7	299
Narrow Neckbanded	588	89.0	-	-	-	-	73	11.0	661
Neck Corrugated	196	79.4	2	0.8	-	-	49	19.8	247
PII Corrugated	1,015	98.5	4	0.4	-	-	11	1.1	1,030
PII-III Corrugated	227	99.6	-	-	-	-	1	0.4	228
PIII Corrugated	103	99.0	-	-	-	-	1	1.0	104
Corrugated	896	62.0	1	0.1	7	0.5	542	37.5	1,446
BMIII-PI Polished M/w	332	56.4	12	2.0	11	1.9	234	39.7	589
BMIII-PI Unpolished M/w	247	52.6	3	0.6	4	0.9	216	46.0	470
Early Red Mesa B/w	300	75.6	29	7.3	17	4.3	51	12.8	397
Late Red Mesa B/w	2,809	73.7	250	6.6	284	7.5	468	12.3	3,811
Escavada B/w	174	82.1	7	3.3	-	-	31	14.6	212
Puerco B/w	367	68.9	12	2.3	14	2.6	140	26.3	533
Gallup B/w	1,096	65.6	70	4.2	55	3.3	451	27.0	1,672
Chaco B/w	33	44.6	1	1.4	3	4.1	37	50.0	74
Exotic Mineral M/w	202	51.1	16	4.1	25	6.3	152	38.5	395
Plain Whiteware	569	50.7	37	3.3	234	20.8	283	25.2	1,123
PII-III Mineral M/w	1,663	67.4	96	3.9	240	9.7	469	19.0	2,468
BMIII-PI Polished C/w	79	41.8	-	-	5	2.6	105	55.6	189
BMIII-P1 Unpolished C/w	43	43.4	1	1.0	-	-	55	55.6	99
PII-III C/w	178	75.7	13	5.5	9	3.8	35	14.9	235
Chaco McElmo B/w	71	78.0	6	6.6	-	-	14	15.4	91
Tusayan Whiteware	72	80.9	8	9.0	4	4.5	5	5.6	89
Chuska B/w	68	59.6	6	5.3	2	1.8	38	33.3	114
Chuska Whiteware	184	75.4	9	3.7	7	2.9	44	18.0	244
Chuska Red Mesa design	74	57.4	11	8.5	13	10.1	31	24.0	129
Mesa Verde B/w	27	64.3	9	21.4	5	11.9	1	2.4	42
Plain Redware	42	33.1	1	0.8	3	2.4	81	63.8	127
Decorated Redware	235	63.5	23	6.2	41	11.1	71	19.2	370
Polychrome	3	37.5	-	-	1	12.5	4	50.0	8
Polished Smudged	261	66.8	12	3.1	15	3.8	103	26.3	391
Exotic Brownware	13	17.3	-	-	5	6.7	57	76.0	75
Navajo Historic	-	-	-	-	-	-	2	100.0	2
Unfired Mudware	7	58.3	-	-	-	-	5	41.7	12
Unknown	-	-	-	-	-	-	1	100.0	1
TOTAL	13,275	65.9	645	3.2	1,060	5.3	5,160	25.6	20,140

Table 2.4. Detailed analysis sample distribution across sites, showing the percentage each site-type group represents of the total site bulk count, the detailed sample, and the total detailed sample for that type.

	29SJ 299-BMIII				29SJ 423				29SJ 1659			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
Plain Gray	16	0.5	3.2	2.1	44	2.3	6.9	5.7	8	1.0	4.1	1.0
Lino Gray	55	1.8	10.9	8.4	47	2.5	7.4	7.2	25	3.2	12.8	3.8
Lino Fugitive	92	3.0	18.3	44.7	4	0.2	0.6	1.9	9	1.2	4.6	4.4
Polished Tan Gray	150	4.8	29.8	27.7	244	13.0	38.3	45.4	102	13.1	52.3	19.0
Wide Neckbanded	10	0.3	2.0	3.3	-	-	-	-	-	-	-	-
Narrow Neckbanded	10	0.3	2.0	1.7	1	0.1	0.2	0.2	-	-	-	-
Neck Corrugated	12	0.4	2.4	4.9	-	-	-	-	-	-	-	-
PII Corrugated	2	0.1	0.4	0.2	-	-	-	-	-	-	-	-
PII-III Corrugated	-	-	-	-	-	-	-	-	-	-	-	-
PIII Corrugated	1	-	0.2	1.0	-	-	-	-	-	-	-	-
Unidentified Corrugated	5	0.2	1.0	0.4	-	-	-	-	-	-	-	-
TOTAL GRAY	353	11.3	70.2	6.0	340	18.1	53.4	5.8	144	18.5	75.0	2.4
BMIII-PI Polished M/w	38	1.2	7.6	6.5	37	2.0	5.8	6.3	25	3.2	12.8	4.2
BMIII-PI Unpolished M/w	34	1.1	6.8	7.2	9	0.5	1.4	1.9	5	0.6	2.6	1.1
Early Red Mesa B/w	3	0.1	0.6	0.8	-	-	-	-	-	-	-	-
Red Mesa B/w	14	0.5	2.8	0.4	-	-	-	-	-	-	-	-
Escavada B/w	-	-	-	-	-	-	-	-	-	-	-	-
Puerco B/w	-	-	-	-	-	-	-	-	-	-	-	-
Gallup B/w	-	-	-	-	-	-	-	-	-	-	-	-
Chaco B/w	-	-	-	-	-	-	-	-	-	-	-	-
Exotic M/w	3	0.1	0.6	0.8	-	-	-	-	-	-	-	-
PII-PII M/w	4	0.1	0.8	0.2	-	-	-	-	-	-	-	-
TOTAL MINERAL-ON-WHITE	96	3.1	19.2	0.9	46	2.4	7.2	0.4	30	3.9	15.6	0.3

Table 2.4. (continued)

	29SJ 299-BMIII				29SJ 423				29SJ 1659			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
BMIII-PI Polished C/w	3	0.1	0.6	1.6	3	0.2	0.5	1.6	1	0.1	0.5	0.5
BMIII-PI Unpolished C/w	1	-	0.2	1.0	-	-	-	-	-	-	-	-
PII-PIII C/w	2	0.1	0.4	0.9	-	-	-	-	-	-	-	-
Mesa Verde B/w	2	0.1	0.4	4.8	-	-	-	-	-	-	-	-
Chaco-McElmo B/w	-	-	-	-	-	-	-	-	-	-	-	-
Chuska B/w	-	-	-	-	-	-	-	-	-	-	-	-
Chuska Whiteware	-	-	-	-	1	0.1	0.2	0.4	-	-	-	-
Red Mesa Chuska	3	0.1	0.6	2.3	-	-	-	-	-	-	-	-
Tusayan Whiteware	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL CARBON-ON-WHITE	11	0.4	2.2	0.9	4	0.2	0.6	0.3	1	0.1	0.5	0.5
Unidentified Whiteware	35	1.1	7.0	3.1	61	3.2	9.6	5.4	6		3.1	5.3
TOTAL WHITEWARE	142	4.6	28.3	1.1	111	5.9	17.4	0.9	37	4.8	19.3	0.3
Plain Red	-	-	-	-	88	4.7	13.8	69.3	1	0.1	0.5	0.8
Decorated Red	1	-	0.2	0.3	-	-	-	-	-	-	-	-
Polychrome	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL REDWARE	1	-	0.2	0.3	88	4.7	13.8	17.4	1	0.1	0.5	0.2
Polished Smudged	6	0.2	1.2	1.5	32	1.7	5.0	8.2	7	0.9	3.6	1.8
Brownware	-	-	-	-	66	3.5	10.4	88.0	2	0.3	1.0	2.7
Mudware	1	-	0.2	8.3	-	-	-	-	1	0.1	0.5	8.3
Navajo	-	-	-	-	-	-	-	-	-	-	-	-
GRAND TOTAL	503	16.2	100.0	2.5	637	33.9	100.0	3.2	192	24.7	99.9	1.0

Table 2.4. (continued)

	29SJ 628				29SJ 299-PI				29SJ 724				29SJ 721			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
Plain Gray	149	2.2	17.2	19.5	69	6.9	27.9	9.0	120	4.2	22.1	15.7	19	3.1	13.2	2.5
Lino Gray	204	3.0	23.6	31.4	26	2.6	10.5	4.0	65	2.3	12.0	10.0	14	2.3	9.8	2.2
Lino Fugitive	45	0.7	5.2	21.8	23	2.3	9.3	11.2	7	0.2	1.3	3.4	8	1.3	5.6	5.6
Polished Tan Gray	7	0.1	0.8	1.3	5	0.5	2.0	0.9	-	-	-	-	24	4.0	16.7	4.5
Wide Neckbanded	1	-	0.1	0.3	4	0.4	1.6	1.3	-	-	-	-	2	0.3	1.4	0.7
Narrow Neckbanded	4	0.1	0.5	0.7	10	1.0	4.1	1.7	1	-	0.2	0.2	-	-	-	-
Neck Corrugated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PII Corrugated	1	-	0.1	0.1	2	0.2	0.8	0.2	-	-	-	-	-	-	-	-
PII-III Corrugated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PIII Corrugated	-	-	-	-	1	0.1	0.4	1.0	-	-	-	-	-	-	-	-
Unidentified Corrugated	2	-	0.2	0.1	13	1.3	5.3	0.9	-	-	-	-	1	0.2	0.7	0.1
TOTAL GRAY	414	6.0	47.8	7.0	153	15.4	61.9	2.6	193	6.7	35.6	3.3	68	11.2	47.2	1.2
BMIII-PI Polished M/w	87	1.3	10.0	14.8	11	1.1	4.5	1.9	69	2.4	12.7	11.7	26	4.3	18.1	4.4
BMIII-PI Unpolished M/w	120	1.7	13.8	25.5	11	1.1	4.5	2.3	133	4.6	24.5	28.3	13	2.1	9.0	2.8
Early Red Mesa B/w	3	-	0.4	0.8	3	0.3	1.2	0.8	-	-	-	-	-	-	-	-
Red Mesa B/w	2	-	0.2	0.1	14	1.4	5.7	0.4	1	-	0.2	0.03	-	-	-	-
Escavada B/w	-	-	-	-	1	0.1	0.4	0.5	-	-	-	-	-	-	-	-
Puerco B/w	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gallup B/w	1	-	0.1	0.1	5	0.5	2.0	0.3	-	-	-	-	-	-	-	-
Chaco B/w	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exotic M/w	1	-	0.1	0.3	3	0.3	1.2	0.8	-	-	-	-	1	0.2	0.7	0.3
PII-III M/w	3	-	0.4	0.1	8	0.8	3.2	0.3	2	0.1	0.4	0.1	-	-	-	-
TOTAL MINERAL-ON-WHITE	217	3.1	25.0	2.0	56	5.6	22.7	0.5	205	7.1	37.8	1.9	40	6.6	27.8	0.4

Table 2.4. (continued)

	29SJ 628				29SJ 299-PI				29SJ 724				29SJ 721			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
BMIII-PI Polished C/w	75	1.1	8.7	39.7	2	0.2	0.8	1.1	15	0.5	2.8	7.9	2	0.3	1.4	1.1
BMIII-PI Unpolished C/w	68	1.0	7.8	68.7	2	0.2	0.8	2.0	6	0.2	1.1	6.1	-	-	-	-
PII-III C/w	1	-	0.1	0.4	2	0.2	0.8	0.9	-	-	-	-	2	0.3	1.4	0.9
Mesa Verde B/w	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chaco-McElmo B/w	2	-	0.2	2.2	-	-	-	-	-	-	-	-	1	0.2	0.7	1.1
Chuska B/w	-	-	-	-	2	0.2	0.8	1.8	-	-	-	-	1	0.2	0.7	0.9
Chuska Whiteware	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2	0.7	0.4
Red Mesa Chuska	1	-	0.1	0.8	1	0.1	0.4	0.8	1	-	0.2	0.8	-	-	-	-
Tusayan Whiteware	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL CARBON-ON-WHITE	147	2.1	17.0	11.9	9	0.9	3.6	0.7	22	0.8	4.1	1.8	7	1.2	4.9	0.6
Unidentified Whiteware	36	0.5	4.2	3.2	19	1.9	7.7	1.7	28	1.0	5.2	2.5	18	3.0	12.5	1.6
TOTAL WHITEWARE	400	5.8	46.1	3.1	84	8.4	34.0	0.6	255	8.9	47.0	2.0	65	10.7	45.1	0.5
Plain Red	7	0.1	0.8	5.5	-	-	-	-	14	0.5	2.6	11.0	2	0.3	1.4	1.6
Decorated Red	1	-	0.1	0.3	9	0.9	3.6	2.4	29	1.0	5.4	7.8	1	0.2	0.7	0.3
Polychrome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL REDWARE	8	0.1	0.9	1.6	9	0.9	3.6	1.8	43	1.5	8.0	8.5	3	0.5	2.1	0.6
Polished Smudged	39	0.6	4.5	10.0	1	0.1	0.4	0.3	49	1.7	0.4	0.3	8	1.3	5.6	2.1
Brownware	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mudware	6	0.1	0.7	50.0	-	-	-	-	-	-	-	-	-	-	-	-
Navajo	-	-	-	-	-	-	-	-	2	0.1	0.4	100.0	-	-	-	-
GRAND TOTAL	867	12.6	100.0	4.4	247	24.8	99.9	1.2	542	18.9	100.0	2.7	144	23.7	100.0	0.7

Table 2.4. *(continued)*

	29SJ 629				29SJ 1360				29SJ 627			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
Plain Gray	88	0.3	5.2	11.5	54	0.4	2.6	7.1	162	0.2	2.2	21.2
Lino Gray	33	0.1	1.9	5.1	46	0.4	2.2	7.1	136	0.2	1.8	20.7
Lino Fugitive	3	-	0.2	1.5	8	0.1	0.4	3.9	6	-	0.1	2.9
Polished Tan Gray	-	-	-	-	-	-	-	-	6	-	0.1	1.1
Wide Neckbanded	28	0.1	1.6	9.4	77	0.6	3.7	25.8	150	0.2	2.1	50.2
Narrow Neckbanded	64	0.2	3.8	10.6	153	1.2	7.3	25.3	244	0.3	3.4	40.3
Neck Corrugated	45	0.1	2.6	18.2	50	0.4	2.4	20.2	113	0.1	1.5	45.7
PII Corrugated	21	0.1	1.2	2.4	46	0.4	2.2	5.3	556	0.5	7.4	54.0
PII-III Corrugated	6	-	0.4	2.9	-	-	-	-	99	0.1	1.3	43.4
PIII Corrugated	2	-	0.1	1.9	-	-	-	-	47	0.1	0.6	45.2
Unidentified Corrugated	35	0.1	2.1	2.4	8	0.1	0.4	0.6	158	0.2	2.1	10.9
TOTAL GRAY	325	1.0	19.0	5.5	443	3.5	21.2	7.5	1,449	1.7	20.1	24.6
BMIII-PI Polished M/w	144	0.4	8.4	24.5	58	0.5	2.8	9.8	94	0.1	1.3	16.0
BMIII-PI Unpolished M/w	43	0.1	2.5	9.2	34	0.3	1.6	7.2	66	0.1	0.9	14.0
Early Red Mesa B/w	96	0.3	5.6	24.2	116	0.9	5.6	29.2	155	0.2	2.2	39.0
Red Mesa B/w	418	1.3	24.5	11.0	726	5.7	34.8	19.0	2,307	2.7	30.7	60.5
Escavada B/w	3	-	0.2	1.4	8	0.1	0.4	3.8	53	0.1	0.7	25.0
Puerco B/w	22	0.1	1.3	1.3	36	0.3	1.7	2.2	551	0.7	7.3	33.0
Gallup B/w	11	-	0.6	2.1	13	0.1	0.6	2.4	221	0.3	3.1	41.5
Chaco B/w	-	-	-	-	3	-	0.1	4.1	26	-	0.4	35.1
Exotic M/w	29	0.1	1.7	7.3	37	0.3	1.8	9.4	166	0.2	2.2	42.0
PII-PIII M/w	381	1.2	22.3	15.4	358	2.8	17.2	14.5	1,044	1.2	14.5	42.3
TOTAL MINERAL-ON-WHITE	1,147	3.5	67.2	10.8	1,390	10.9	66.6	13.1	4,683	5.5	64.8	44.1

Table 2.4. (continued)

	29SJ 629				29SJ 1360				29SJ 627			
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type
BMIII-PI Polished C/w	30	0.1	1.9	15.9	22	0.2	1.1	11.6	33	-	0.5	17.5
BMIII-PI Unpolished C/w	5	-	0.3	5.1	1	-	0.1	1.0	16	-	0.2	16.2
PII-III C/w	12	-	0.7	5.1	5	-	0.2	2.1	71	0.1	1.0	30.2
Mesa Verde B/w	2	-	0.1	4.8	-	-	-	-	2	-	-	4.8
Chaco-McElmo B/w	7	-	0.4	7.7	1	-	0.1	1.1	1	-	-	1.1
Chuska B/w	3	-	0.2	2.6	2	-	0.1	1.8	24	-	0.3	21.1
Chuska Whiteware	5	-	0.3	2.1	15	0.1	0.7	6.2	82	0.1	1.1	33.6
Red Mesa Chuska	8	-	0.5	6.2	28	0.2	1.3	21.7	58	0.1	0.8	45.0
Tusayan Whiteware	-	-	-	-	-	-	-	-	45	0.1	0.6	50.6
TOTAL CARBON-IN-WHITE	72	0.2	4.2	5.8	74	0.6	3.5	6.0	332	0.4	4.6	26.9
Unidentified Whiteware	101	0.3	5.9	9.0	135	1.1	6.5	12.0	545	0.6	7.5	48.5
TOTAL WHITEWARE	1,320	4.0	77.3	10.2	1,599	12.5	76.6	12.3	5,560	6.6	77.0	42.8
Plain Red	7	-	0.4	5.5	1	-	0.5	0.8	2	-	-	1.6
Decorated Red	34	0.1	2.0	9.2	23	0.2	1.1	6.2	135	0.2	1.9	36.5
Polychrome	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL REDWARE	41	0.1	2.4	8.1	24	0.2	1.1	4.8	137	0.2	1.9	27.1
Polished Smudged	20	0.1	1.2	5.1	22	0.2	1.1	5.6	76	0.1	1.1	19.4
Brownware	1	-	0.1	1.3	-	-	-	-	3	-	-	4.0
Mudware	-	-	-	-	-	-	-	-	-	-	-	-
Navajo Utility	-	-	-	-	-	-	-	-	-	-	-	-
GRAND TOTAL	1,707	5.2	100.0	8.6	2,088	16.3	100.0	10.5	7,518	8.6	100.1	36.4

Table 2.4. *(continued)*

	29SJ 633				29SJ 389 (Pueblo Alto)				Grand Total		
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Detailed	% Bulk Type
Plain Gray	8	0.1	2.5	1.0	29	-	0.5	3.8	766	3.8	1.6
Lino Gray	1	-	0.3	0.2	-	-	-	-	653	3.2	45.7
Lino Fugitive	1	-	0.3	0.5	-	-	-	-	206	1.0	14.4
Polished Tan/Gray	-	-	-	-	-	-	-	-	538	2.7	53.0
Wide Neckbanded	1	-	0.3	0.3	17	-	0.3	5.7	299	1.5	19.7
Narrow Neckbanded	8	0.1	2.5	1.3	110	0.1	2.0	18.2	661	3.3	4.5
Neck Corrugated	3	-	0.9	1.2	24	-	0.5	9.7	247	1.2	17.1
PII Corrugated	10	0.1	3.1	1.2	392	0.4	7.3	45.0	1,030	5.1	57.9
PII-III Corrugated	8	0.1	2.5	3.5	115	0.1	2.1	50.4	228	1.1	35.7
PIII Corrugated	7	0.1	2.2	6.7	46	0.1	0.9	44.2	104	0.5	63.8
Unidentified Corrugated	40	0.5	12.6	2.8	1,184	1.3	22.0	81.9	1,446	7.2	2.1
TOTAL GRAY	87	1.1	27.4	1.5	1,917	2.1	35.6	32.6	5,998	29.6	4.2
BMIII-PI Polished M/w	-	-	-	-	-	-	-	-	589	2.9	90.1
BMIII-PI Unpolished M/w	-	-	-	-	2	-	-	0.4	470	2.3	49.4
Early Red Mesa B/w	-	-	-	-	21	-	0.4	5.3	397	2.0	16.8
Red Mesa B/w	16	0.2	5.0	0.4	314	0.3	5.8	8.2	3,811	18.9	22.9
Escavada B/w	5	0.1	1.6	2.4	142	0.2	2.6	62.0	212	1.1	18.8
Puerco B/w	3	-	0.9	0.6	285	0.3	5.3	53.5	1,672	2.6	17.9
Gallup B/w	14	0.2	4.4	0.8	1,043	1.2	19.4	62.4	533	8.3	12.6
Chaco B/w	3	-	0.9	4.1	42	-	0.8	56.8	74	0.4	15.3
Exotic M/w	18	0.2	5.7	4.6	137	0.2	2.5	34.7	395	2.0	64.1
PII-III M/w	50	0.7	15.7	2.0	618	0.7	11.5	25.0	2,468	12.4	10.8
TOTAL MINERAL-ON-WHITE	109	1.4	34.3	1.0	2,604	2.9	48.4	24.5	10,623	53.5	17.1

Table 2.4. *(continued)*

	29SJ 633				29SJ 389 (Pueblo Alto)				Grand Total		
Ware	No.	% Site RS	% Detailed	% Type	No.	% Site RS	% Detailed	% Type	No.	% Detailed	% Bulk Type
BMIII-PI Polished C/w	2	-	0.6	1.1	1	-	-	0.5	189	0.9	46.4
BMIII-PI Unpolished C/w	-	-	-	-	-	-	-	-	99	0.5	39.3
PII-III C/w	42	0.5	13.2	17.9	98	0.1	1.8	41.7	235	1.2	7.3
Mesa Verde B/w	32	0.4	10.1	76.2	4	-	0.1	9.5	42	0.2	26.4
Chaco-McElmo B/w	2	-	0.6	2.2	77	0.1	1.4	84.6	91	0.5	11.1
Chuska B/w	1	-	0.3	0.9	81	0.1	1.5	71.1	114	0.6	20.1
Chuska Whiteware	2	-	0.6	0.8	138	0.2	2.6	56.6	244	1.2	21.3
Red Mesa Chuska	-	-	-	-	29	-	0.5	22.5	129	0.6	41.2
Tusayan Whiteware	-	-	-	-	44	-	0.8	49.4	89	0.4	21.2
TOTAL CARBON-ON-WHITE	81	1.1	25.5	6.6	472	0.5	8.8	38.3	1,232	6.2	15.4
Unidentified Whiteware	23	0.3	7.2	2.1	117	0.1	2.2	10.4	1,124	5.7	3.9
TOTAL WHITEWARE	213	2.8	67.0	1.6	3,198	3.5	59.4	24.6	12,984	5.4	13.2
Plain Red	1	-	0.3	0.8	4	-	0.1	3.2	127	0.6	65.1
Decorated Red	12	0.2	3.8	3.3	125	0.1	2.3	33.8	370	1.9	16.9
Polychrome	4	0.1	1.3	50.0	4	-	0.1	50.0	8	-	23.5
TOTAL REDWARE	17	0.2	5.3	3.4	133	0.1	2.5	26.3	505	2.5	20.9
Polished Smudged	1	-	0.3	0.3	130	0.1	2.4	33.3	391	1.9	18.4
Brownware	-	-	-	-	3	-	0.1	4.0	75	0.4	100.0
Mudware	-	-	-	-	4	-	0.1	33.3	12	0.1	10.6
Navajo Utility	-	-	-	-	-	-	-	-	2	-	-
				8.6				10.5			
GRAND TOTAL	1,707	5.2	100.0	8.6	2,088	16.3	100.0	10.5	19,848	-	-

Column key:

No. = number of specimens of this type from this site in the detailed sample.
% Site RS = number divided by the bulk count for the site.
% Detailed = number divided by the site's whole detailed sample.
% Type = number divided by the number of specimens of the type in the total detailed sample.
% Bulk Type = detailed number divided by bulk number for each type.

detailed analysis, but this, of course, makes the sample less systematic. Generally, the rough sort counts do not reflect matching, while the detailed counts do. This has the effect of depressing the percentages slightly when comparing detailed counts to rough sort counts. Worked sherds were also included in the detailed sample. The intent of the detailed analysis was to include all observations on each sherd/vessel, but exigencies of time and avoidance of "nipping" some specimens meant that temper was not observed for all items in the detailed analysis.

What is this sample, then? Particularly in the time span from around A.D. 950 to 1150, it is large enough to likely represent the assemblage of vessel forms, designs, sources, and other attributes in use in Chaco during those centuries. Based on the detailed analysis sample, Table 2.5 summarizes the occurrence of the ceramic types by time groups. The time groups shown in the table, which were established for the entire Chaco Project, were based primarily on ceramics but also on other contextual and chronological considerations. All the time periods are shown in Table 2.5, but ensuing tables use only the time segments of a hundred years or less, omitting the ambiguous, long-span groups. This practice reduces the sample size, but makes the temporal trend in question more reliable.

Type Descriptions

Types as Temporal Control

Our analyses of the ceramics from Chaco attempted to push the amount of information obtained from this artifact class, but there is little doubt that chronological placement of deposits remained the most important contribution of ceramic classification. The remarkable regularity over space and relative rapidity with which pottery decoration and manipulation changed through time in the northern Southwest provide the basis for much of what archeologists have been able to figure out about cultural process and history. Windes (1987:240-248 et seq., 1993:307-335) discusses at length the project's use of ceramics, temporal control, and the association of absolute dates with ceramic assemblages.

Type Definitions

Placement of ceramics into type groups is much debated and sometimes treated as nearly mystical. The system of type identification has a long history and has become extremely complicated (see Colton and Hargrave 1937; Oppelt 1988). Each analyst brings his own template for types to the process of dividing a collection of pottery into groups. These templates are based on the individual's training and understanding of published descriptions, and they evolve as the individual handles more and more sherds. Peter McKenna and Thomas Windes made almost all of the type assignments for the Chaco Project. They both received training from Florence Hawley Ellis and Alden Hayes, both of whom have long histories of pottery description (see, for example, Hawley 1936; Hayes 1964, Hayes and Lancaster 1975). Hayes directed the survey and thus McKenna and Windes worked closely with him and could become clear on his understanding of type definitions. Toll received some training from David Breternitz, but most of his understanding of types came through working with McKenna and Windes.

The definitions in Appendix 2A are based on this cumulative experience and are taken from several sources: Windes' (1984b) summary of Chaco Cibola series for the second Cibola Whiteware Conference (1958) (also Windes 1985); Windes' (1977) work with the Coal Gasification Project (CGP) ceramics from the Chuska area, which in turn relied on the work of Peckham and Wilson (1964); Windes and McKenna's (1989) descriptions of types for a New Mexico Archaeological Council ceramics workshop; and a series of type descriptions found in the ceramics sections of site reports (McKenna and Toll 1984, 1991; Toll and McKenna 1987, 1992, 1993). Some of the groups defined here are types in the traditional sense: Red Mesa, Puerco, Escavada, Gallup, Chaco, Chaco McElmo, Chuska, and Mesa Verde Black-on-whites conform to established decorated types, as does Lino Gray, among the utility wares. Other groups are broader sorting categories, intended for a greater refinement phase which was not carried out, primarily because of changes in personnel. Appendix 2A provides the criteria used in including ceramics in the various groups. The sorting categories which are not conventional types, such as Basketmaker III-Pueblo I Polished Mineral-on-white or Pueblo II-III Mineral-on-white, or unidentified whiteware cover two situations: sherds that could be placed into less common, more specific types and sherds that lack sufficient decoration or size to be placed into a type. In cases which could have been more specifically typed, some chronological

Table 2.5. Occurrence of ceramic types in time groups, detailed analysis sample.

	A.D.											
Ware	500s	600s	700-820	820-920	920-1020	1020-1120	1120-1220	920-1120	820-1220[a]	1220-1320	820-1020	500-1200
Plain Gray	44	16	211	27	145	21	-	29	8	1	15	13
Lino Gray	47	58	117	20	93	1	-	9	1	-	21	30
Wide Neckbanded	-	-	17	24	141	5	1	13	1	-	5	2
Narrow Neckbanded	1	1	19	23	251	78	-	58	6	-	12	1
PII Corrugated	-	-	2	6	112	335	20	28	1	-	1	1
PII-III Corrugated	-	-	-	-	9	38	73	3	1	1	-	-
PIII Corrugated	-	-	1	-	5	13	33	2	1	1	-	-
Unident. Corrugated	-	-	13	5	98	939	92	12	5	5	3	3
Neck Corrugated	-	-	1	4	141	9	-	16	4	-	4	1
Lino Fugitive Red	4	92	38	2	5	-	-	1	-	-	3	12
Obelisk Gray	243	232	23	-	4	-	-	-	-	-	-	23
GRAYWARE TOTAL	339	399	442	111	1,004	1,439	219	171	28	8	64	86
Grayware Percent	5.6	6.6	7.3	1.8	16.6	23.8	3.6	2.8	0.5	0.1	1.1	1.4
Temporal Percent	59.3	79.3	49.0	29.8	28.1	44.8	30.5	28.5	26.9	40.0	25.7	61.4
BMIII-PI M/w Polished	37	56	111	41	144	-	-	17	4	-	36	10
BMIII-PI M/w Unpolished	9	28	163	18	46	1	1	13	1	-	13	20
Early Red Mesa B/w	-	-	8	22	208	8	-	30	3	-	24	2
Red Mesa B/w	-	-	32	139	1,643	129	6	252	33	-	70	2
Escavada B/w	-	-	1	-	12	103	28	2	1	1	-	-
Puerco B/w	-	-	-	-	46	225	30	11	1	-	3	-
Gallup B/w	-	-	5	2	101	877	53	28	6	-	1	-
Chaco B/w	-	-	-	-	1	31	9	2	-	2	-	-
Exotic M/w	-	-	4	7	61	83	36	16	2	1	8	1
MINERAL-ON-WHITE TOTAL	46	84	324	229	2,262	1,457	163	371	51	4	155	35
Mineral-on-white Percent	0.6	1.1	4.1	2.9	28.6	18.4	2.1	4.7	0.6	-	1.9	0.4
Temporal Percent	8.0	16.7	35.9	61.4	63.4	45.3	22.7	61.7	49.0	20.0	62.3	25.0

Table 2.5. (continued)

	A.D.									
Ware	920-1320	1120-1320	1020-1040	700-1020	1020-1220	900-1120	820-1120	600-820	Total	% N
Plain Gray	2	2	49	8	-	22	2	141	756	4.7
Lino Gray	-	-	42	71	-	10	3	118	641	4.0
Wide Neckbanded	-	-	59	-	-	14	4	1	287	1.8
Narrow Neckbanded	5	1	112	-	3	45	15	3	634	3.9
PII Corrugated	6	4	204	1	25	246	12	-	1,004	6.2
PII-III Corrugated	5	2	22	-	6	61	4	-	225	1.4
PIII Corrugated	5	1	11	-	-	29	1	-	103	0.6
Unident. Corrugated	26	8	91	-	89	42	4	2	1,437	8.9
Neck Corrugated	3	-	30	-	1	10	4	-	228	1.4
Lino Fugitive Red	1	-	2	18	-	1	-	24	203	1.3
Obelisk Gray	-	-	2	-	-	1	-	7	535	3.3
GRAYWARE TOTAL	53	18	624	98	124	481	49	296	6,053	37.5
Grayware Percent	0.9	0.3	10.3	1.6	2.0	8.0	0.8	4.9	100.0	-
Temporal Percent	33.8	38.3	29.8	41.0	41.5	30.3	23.8	54.1	-	
BMIII-PI M/w polished	-	-	30	22	-	15	1	61	585	3.6
BMIII-PI M/w unpolished	-	-	18	45	1	10	4	71	462	2.9
Early Red Mesa B/w	-	-	40	1	2	12	12	2	374	2.3
Red Mesa B/w	14	2	790	1	19	436	101	-	3,669	22.7
Escavada B/w	2	-	20	-	8	30	1	-	209	1.3
Puerco B/w	2	1	62	-	21	117	6	-	525	3.4
Gallup B/w	8	1	271	1	63	217	8	-	1,642	10.2
Chaco B/w	1	-	2	-	3	20	-	-	71	0.4
Exotic M/w	12	2	59	1	12	72	7	-	384	2.4
MINERAL-ON-WHITE TOTAL	39	6	1,292	71	129	929	140	134	7,921	49.1
Mineral-on-white Percent	0.5	0.1	16.3	0.9	1.6	11.7	1.8	1.7	100.0	-
Temporal Percent	24.8	12.8	61.8	29.7	43.1	58.2	68.0	24.5	-	-

Table 2.5. *(continued)*

	A.D.											
Ware	500s	600s	700-820	820-920	920-1020	1020-1120	1120-1220	920-1120	820-1220[a]	1220-1320	920-1020	500-1200
BMIII-PI C/w polished	3	2	19	8	40	-	-	6	3	-	8	3
BMIII-PI C/w unpolished	-	-	9	-	14	-	-	-	-	-	3	1
PII-III C/w	-	-	-	1	34	11	77	8	5	2	2	2
Mesa Verde B/w	-	-	-	-	2	-	3	-	-	6	-	2
Chaco-McElmo B/w	-	-	-	-	1	1	71	2	4	-	1	1
Tusayan C/w	-	-	-	-	3	25	13	3	-	-	-	-
Chuska B/w	-	-	1	-	3	56	17	2	2	-	1	1
Chuska C/w	-	-	2	4	36	65	64	9	-	-	-	1
Chuska Red Mesa design	-	-	2	7	51	14	1	6	3	-	1	1
CARBON-ON-WHITE TOTAL	3	2	33	20	184	172	246	36	17	8	16	12
Carbon-on-white Percent	0.2	0.2	2.7	1.6	15.2	14.2	20.3	3.0	1.4	0.7	1.3	1.0
Temporal Percent	0.5	0.4	3.7	5.4	5.2	5.4	34.3	6.0	16.4	40.0	6.4	8.6
Polished Smudged	32	13	55	3	47	85	32	6	5	-	-	4
Smudged Percent	8.3	3.4	14.3	0.8	12.2	22.1	8.3	1.6	1.3	-	-	1.0
Temporal Percent	5.6	2.6	6.1	0.8	1.3	2.6	4.5	1.0	4.8	-	-	2.9
Brownware	66	2	-	-	-	1	2	-	-	-	1	-
Mudware	-	2	-	-	-	-	-	-	-	-	-	-
Temporal Percent	11.5	0.8	-	-	-	t	0.3	-	-	-	0.4	-
Plain Red	86	1	14	2	3	-	3	1	1	-	3	3
Decorated Red	-	-	34	8	67	62	48	16	2	-	10	-
Polychrome	-	-	-	-	-	-	4	-	-	-	-	-
REDWARE TOTAL	86	1	48	10	70	62	55	17	3	-	13	3
Redware Percent	17.4	0.2	9.7	2.0	14.2	12.6	11.2	3.5	0.6	-	2.6	0.6
Temporal Percent	15.0	0.2	5.3	2.7	2.0	1.9	7.7	2.8	2.9	-	5.2	2.1
TEMPORAL TOTAL	572	503	902	373	3,567	3,216	717	601	104	20	249	140
PERCENT	3.5	3.1	5.6	2.3	22.1	19.9	4.4	3.7	0.6	0.1	1.5	0.9

[a] Included time group A.D. 920-1220, n = 16.

t = trace.

Table 2.5. *(continued)*

	A.D.									
Ware	920-1320	1120-1320	1020-1040	700-1020	1020-1220	900-1130	820-1120	600-820	Total	% N
BMIII-PI C/w polished	2	-	9	25	-	6	2	47	183	1.1
BMIII-PI C/w unpolished	-	-	5	32	-	1	-	33	98	0.6
PII-III C/w	24	15	19	-	11	17	4	-	232	1.4
Mesa Verde B/w	23	3	1	-	1	1	-	-	42	0.3
Chaco-McElmo B/w	2	-	-	2	4	1	-	-	90	0.6
Tusayan C/w	-	-	9	-	5	29	1	-	88	0.5
Chuska B/w	1	-	13	-	5	10	-	-	112	0.7
Chuska C/w	2	-	23	-	6	24	3	-	239	1.5
Chuska Red Mesa design	-	-	29	1	2	9	2	-	129	0.8
CARBON-ON-WHITE TOTAL	54	18	108	60	34	98	12	80	1,213	7.5
Carbon-on-white Percent	-	-	-	-	-	-	-	-	-	-
Temporal Percent	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Polished Smudged	32	13	55	3	47	85	32	6	5	4
Smudged Percent	-	-	-	-	-	-	-	-	-	-
Temporal Percent	-	-	-	-	-	-	-	-	-	-
Brownware	66	2	-	-	-	1	2	-	-	1
Mudware	-	2	-	-	-	-	-	-	-	-
Temporal Percent	-	-	-	-	-	-	-	-	-	-
Plain Red	86	1	14	2	3	-	3	1	1	3
Decorated Red	-	-	34	8	67	62	48	16	2	10
Polychrome	-	-	-	-	-	-	4	-	-	-
REDWARE TOTAL	-	-	-	-	-	-	-	-	-	-
Redware Percent	-	-	-	-	-	-	-	-	-	-
Temporal Percent	-	-	-	-	-	-	-	-	-	-
TEMPORAL TOTAL	-	-	-	-	-	-	-	-	-	-
PERCENT	-	-	-	-	-	-	-	-	-	-

tightness is lost. Others of these categories, such as Pueblo II-III Mineral-on-white, unidentified whiteware, unidentified corrugated, or plain gray are necessary in any archeological analysis for items which cannot be typed. The grayware sorting categories monitor temporally sensitive attributes closely enough that little chronological information was lost. Even more than the early decorated wares, where the rough sort "types" cost some resolution, the categories for exotic pottery resulted in lost information: polished smudged, decorated red, plain red, Pueblo II-III Carbon-on-white and exotic mineral-on-white each subsume several more traditional types that would have provided useful information as to date and source. In the Chuska carbon paint series Chuska Black-on-white was identified, as was Chuska carbon paint with Red Mesa designs, which groups Tunicha, Burnham, and Newcomb Black-on-whites, but preserves temporal placement. Other Chuska types were placed in the broader Chuska Carbon-on-white group.

An important part of each type definition is the set of attribute tabulations taken from the detailed analysis (see Appendix 2A). The tables in Appendix 2A quantify at some length the constellations of attributes that fit into types as perceived by these analysts. There are, of course, many aspects of placing a sherd in a type that cannot be coded for a computer; these descriptions attempt to provide some of those less quantifiable attributes. In using these tables the reader will notice that not all attributes add to the total number of specimens in the type group. Cases with missing observations are not included in the tabulations. Missing observations result from several circumstances: inability to observe an attribute (such as temper in a very small or worked sherd), changes in recording systems (see Temper and Paste section), and occasional uncorrected coding or keypunching errors.

A range of statistical techniques was used to aid in summarizing and comparing the typological and technological groups created by the analysis. Most of these techniques are simple, such as means and standard deviations and chi-square analyses of distributions. At the time when most of the analysis was performed, we were excited by the prospect of being able to quantify diversity of various attributes as a means of evaluating the likelihood of specialized production having taken place; as discussed in the Ceramic Production section, it has been widely assumed that specialized production will be manifested in pottery as reduced variability (e.g., Rice 1981). The widely-used Shannon Weaver indices of heterogeneity, evenness, and richness from ecology (Pielou 1969) have great conceptual appeal because they provide apparently comparable numbers that take into account the frequency of categories and their distribution within a sample. Jim Judge devised a computer routine that calculated the Shannon Weaver diversity and evenness indices using natural logs (as presented by Lasker 1976), which we used on a wide variety of distributions, including design elements and vessel forms. We were aware that sample size had an impact on results, but we were not aware that this technique assumes infinite samples nor were we cognizant of the complexity—and controversy—involved in the interpretation of these indices (Bobrowsky and Ball 1989; Kintigh 1984; Peet 1974). Although these indices are not comparable across types with greatly differing sample sizes, all the elements are not equivalent, and there are statistical arguments about measuring diversity, they nonetheless do give an idea of the complexity of design within the types, and they have been left in the tables.

As is true of many typological analyses, different attributes were given different weight. In this analysis, for example, paint type was a critical attribute, slipping was important but not absolutely critical, and temper and surface treatment were more important in some types than in others. Other analyses use temper as a critical attribute and put less weight on paint type, while still others cite design as most important. Because of its temporal significance, design style would make the most useful basis for classification at the highest level; this is more or less the approach endorsed and followed by Goetze and Mills (1993:24), although technological attributes crosscut some design categories in their analysis as well.

In retrospect, the present analysis could have been best served by having a strictly design-based classification within which attributes such as temper, paint type, and slip could have been monitored. This state was most nearly attained in the graywares, which were grouped strictly by rim form and surface treatment, with other attributes monitored in terms of those groups. Decorated groups were treated more variably. Type names carry polythetic, unquantifiable information in a four-tier typology: ware, design style, traditional detailed type, and rough sort type. Many sherds could not be placed in all four tiers, but in a "detailed analysis," each should be pushed as far as possible.

Ware Assemblages through Time

Implicit in all the type assignments is a higher level assignment to a ware group. In the Chaco assemblage there are four ware groups: gray, white, red, and brown. Placement in a ware group is based on surface and paste texture, decoration, and, of course, surface color. Usually there is little ambiguity in ware placement, although in some coarser earlier sherds and in cases of misfiring, there can be some question. Within these ware-color groups there are some basic subdivisions: whitewares can be divided by paint type (mineral versus organic paint), and the "red" wares include "orange" ware, and, in fact many redware sherds are more orange than red. Most, but not all, of the brownwares here are polished smudged vessels. The occurrence of these various wares in Chaco changes substantially through time. Table 2.6 presents the wares by well-defined time groups within the detailed analysis sample. Several important trends are visible in the data. Early assemblages are dominated by gray, red, and brownwares, with the occurrence of whitewares gaining greatly after A.D. 800 (see also Wilson and Blinman 1995:75). The earliest brownwares are probably from early experimentation with self-tempered alluvial clays, and the early redwares (and perhaps brownwares) are likely to be nonlocal. Decorated wares are uncommon before the A.D. 700s, as seen in the high percentages of graywares in the A.D. 600s and 700s. The prevalence of mineral-painted whitewares from A.D. 900 to 1100 is clearly visible, as is the switch to carbon paint around A.D. 1100. After the earliest period, red and brownwares are always present, but always in low frequencies.

The Place of Paint Type in Chaco Project Type Definitions

Although design style is often considered primary in making type assignments, paint type is a critical variable in type placement in the system used by the Chaco Project. Although there are a few peculiar placements in the data set such as carbon-painted sherds in "Basketmaker III-Pueblo I Mineral-on-white" or mineral paint codes in Basketmaker III-Pueblo I Carbon-on-white, there are no examples of items with carbon paint having been placed in Gallup or Puerco Black-on-white. Usually a matte black, mineral paint in the Chaco series also occurs in other colors: brown and red may well result from firing variations; rare greenish items may have compositional peculiarities; a small percentage of cases have what has been called "glaze black." Rather than being a true glaze, this is probably thickly applied and highly-fired mineral paint that takes on a shiny, melted appearance similar to glaze paints. There is, of course, observable variability in carbon or organic paint just as there is in mineral paint. Carbon paint is sufficiently rare in these collections, however, that no internal variability was monitored. The final paint type monitored, "mineral-carbon," was used almost exclusively for decorated redware pottery, although it was coded for tiny percentages of a number of whiteware types.

There is a clear association of paint types with time (Table 2.7). In keeping with a pan eastern Anasazi shift at around A.D. 1100, carbon paint is far more abundant in the latest Chaco time periods. Organic paint also occurs above the expected in the Pueblo I time period. Within mineral paints, almost all reddish paint occurs in the earliest vessels, where it is the most common paint type; by the A.D. 900s, red mineral paint is quite rare, presumably because of improved firing atmosphere control (Table 2.8). Brown paint, also presumably the result of firing imperfections, also decreases in frequency through time, although it is present in substantial percentages throughout the sequence. The unusual greenish paint occurs in about the same frequencies in all time periods but farthest above expected in the A.D. 1100 to 1200 period, while mineral glaze is most marked in the A.D. 1040 to 1100 period.

Painted rim decoration is very consistent throughout the mineral paint sequence. Of the post Pueblo I items with observable paint on the rims, 80 to 90 percent are painted with a solid line. Where a solid line is present it nearly always has a small gap. At the end of the sequence, dotted or dashed ("ticked") rim paint becomes popular, especially in carbon-painted vessels such as Chaco McElmo and almost always Mesa Verde Black-on-whites, but ticking makes up a very small percentage of the total assemblage. Carbon-painted vessels more frequently have unpainted rims: the early types have much higher percentages of unpainted rims than painted

Table 2.6. Ware by time group.

	Ware										
	Grayware		Mineral-on-white		Carbon-on-white		Redware		Brownware		
Time (A.D.)	No.	% time	No.	% time	No.	% time	No.	% time	No.	% time	Total No.
500s	339	59.3	46	8.0	3	0.5	86	15.0	98	17.1	572
600s	145	78.0	30	16.1	1	0.5	1	0.5	9	4.8	186
700-820	738	50.1	489	33.2	113	7.7	54	3.7	80	5.4	1,474
820-920	111	24.8	303	67.8	20	4.5	10	2.2	3	0.7	447
920-1040	1,565	23.8	4,534	69.1	283	4.3	116	1.8	68	1.0	6,566
1040-1100	1,439	39.3	1,904	52.0	172	4.7	62	1.7	86	2.3	3,663
1100-1220	219	28.3	224	28.9	246	31.7	52	6.7	34	4.4	775
1220-1320	8	38.1	5	23.8	8	38.1	-	-	-	-	21
TOTAL	4,564		7,535		846		381		378		13,704
% of Total		33.3		55.0		6.2		2.8		2.8	

Table 2.7. *Whiteware paint by time group.*

	Mineral Red		Mineral Brown		Mineral Black		Mineral Green		Carbon		Mineral Glaze		Total	
Time	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A.D. 500s	21	44.7	16	34.0	7	14.9	1	2.1	2	4.3	-	-	47	0.6
A.D. 600s	14	70.0	5	25.0	-	-	-	-	1	5.0	-	-	20	0.2
A.D. 700-820	39	6.4	241	39.8	204	33.7	9	1.5	113	18.6	-	-	606	7.2
A.D. 820-920	7	2.2	89	27.4	201	61.8	2	0.6	22	6.8	4	1.2	325	3.9
A.D. 920-1040	132	2.7	1,096	22.5	3,271	67.1	47	1.0	283	5.8	47	1.0	4,876	57.8
A.D. 1040-1100	39	1.9	498	23.9	1,288	61.8	28	1.3	173	8.3	57	2.7	2,083	24.7
A.D. 1100-1200	7	1.5	74	15.9	115	24.7	13	2.8	246	52.8	11	2.4	466	5.5
Post A.D. 1200	-	-	-	-	5	38.5	-	-	8	61.5	-	-	13	0.2
S TOTAL	259		2,019		5,091		100		848		119		8,436	
% of Total		3.1		23.9		60.3		1.2		10.0		1.4		100.0

Three mineral-carbon (1 in A.D. 920-1040 and 2 in A.D. 1040-1100) are not shown.
$\chi^2 = 1538.6$, df = 20, C = .393, 2 cells expected <5, with mineral carbon eliminated and first three time groups combined and last two time groups combined.

Table 2.8. *Paint by vitrification.*

	Vitrification							
	Absent		Present		Marked		Total	
Paint Type	No.	% of Paint	No.	% of Paint	No.	% of Paint	No.	% of Total
Mineral Red	143	47.0	88	28.9	73	24.0	304	2.9
Mineral Brown	661	28.1	827	35.2	862	36.7	2,350	22.5
Mineral Black	1,129	18.0	1,972	31.4	3,181	50.6	6,282	60.0
Mineral Green	41	35.0	38	32.5	38	32.5	117	1.1
Mineral Carbon	73	25.3	124	42.9	92	31.8	289	2.8
Carbon	233	24.0	468	48.1	271	27.9	972	9.3
Glaze	4	2.7	21	14.1	124	83.2	149	1.4
TOTAL	2,284		3,538		4,641		10,463	
% OF TOTAL		21.8		33.8		44.4		100.0

Painted items with vitrification codes only.

rims and this trend continues into Pueblo II-III Carbon-on-white, although this group has 27 percent dotted rims. Chuskan types have more solid-painted than unpainted rims, but still a predominance of solid-painted rims. The greater frequency of unpainted rims in carbon paint types suggests that it may be more difficult to get carbon paint on the rim to last through the firing process.

Mineral paint is a requisite attribute in this classification for all Cibola Chaco Whiteware types except the latest one, Chaco McElmo Black-on-white.

The Place of Slip in Chaco Project Type Definitions

Slip and surface texture are the two most important attributes used in distinguishing ceramics of the Chaco series (Windes 1984b:100; Windes and McKenna 1989:4). This slip is a flat white, usually applied very sparingly. It is virtually never crackled; indeed, crackled slip would usually result in the item being placed in the exotic category, the empirically-based assumption being that it probably came from north of the San Juan River. Chaco series sherds are generally well-polished, though the degree of polishing varies, which affects the glossiness of the surface. The slip is often washy enough that it is possible to see the body clay through it in some places. In accord with the sparing use of slip, bowl exteriors are often unslipped. Quite commonly on both bowls and jars, the slip was extended over the rim from the slipped surface onto the unslipped surface in a regular band. This practice was named "slip slop" by Roberts (1927:85-86) and was monitored by the detailed analysis (illustrated in Windes 1984b:101-102 and 1985:25, 28). Slips were uncommon in the earliest decorated types, becoming commonly used in Early Red Mesa Black-on-white (mid A.D. 800s). Over two-thirds of Red Mesa Black-on-white bowls are slipped on both sides, but after that time slip coverage decreased. In Puerco, Escavada, and Gallup Black-on-white bowls combined, only 24 percent are slipped both sides, with slip slop on 19 percent and 42 percent slipped only on the interior.

The Place of Temper in Chaco Project Type Definitions

Most type descriptions include mention of the predominant tempering material, and temper is a prime criterion for separation of many whole typological series. Modally, Chaco Cibola types contain some form of sand and ground-up sherds for temper, and those tempers are used to identify that series in locations where it is not common. After Pueblo I, three-quarters or more of all Cibola Whitewares contain sherd temper, although its use in Chuskan types is considerably less (Figure 2.2C). As can be seen from the type tables in Appendix 2A, temper was not used as a primary criterion for type placement in the Chaco Project analysis. For example, a whole series of type names has been created for mineral-painted, trachyte-tempered ceramics (see Peckham and Wilson 1964; Windes 1977), but sherds displaying these attributes were included in the more general Cibola type names here. This is not to say that type placements were "temper blind." Some tempers are quite evident through visual inspection, and sherds that were unusual or difficult to classify were examined under magnification, so that the analysts were more often than not aware of the temper as they typed sherds.

Trachyte-tempered, mineral-painted, black-on-white pottery in these collections is virtually identical to other Cibola series pottery in slip, design, and paint, and inclusion of these items in one group makes sense. There is no doubt that pottery from a large area is present in this more inclusive group, most of which cannot be as finely sourced as pottery tempered with trachyte. The primary influences of temper on typological placement were to place mineral-painted items in the "exotic mineral" group (though surface texture was at least as important in these placements), and to place Chuskan Whitewares with organic paint in their appropriate type groups. Since the graywares were not placed in typological groups during the analysis, temper had little effect on grayware typing.

The references for primary types given in the descriptions in Appendix 2A are those which most nearly match the usage in this analysis, or where we have provided detailed descriptions of our use. Types with similar design styles from other ceramic series have been indicated. Standard references for other series include Peckham and Wilson (1964) and Windes (1977) for the Chuska series, Breternitz et al. (1974) for the Mesa Verde series, and Colton and Hargrave (1937) for Tusayan types.

Red and orange pottery—redwares—found in Chaco fall into five groups which are distinguished

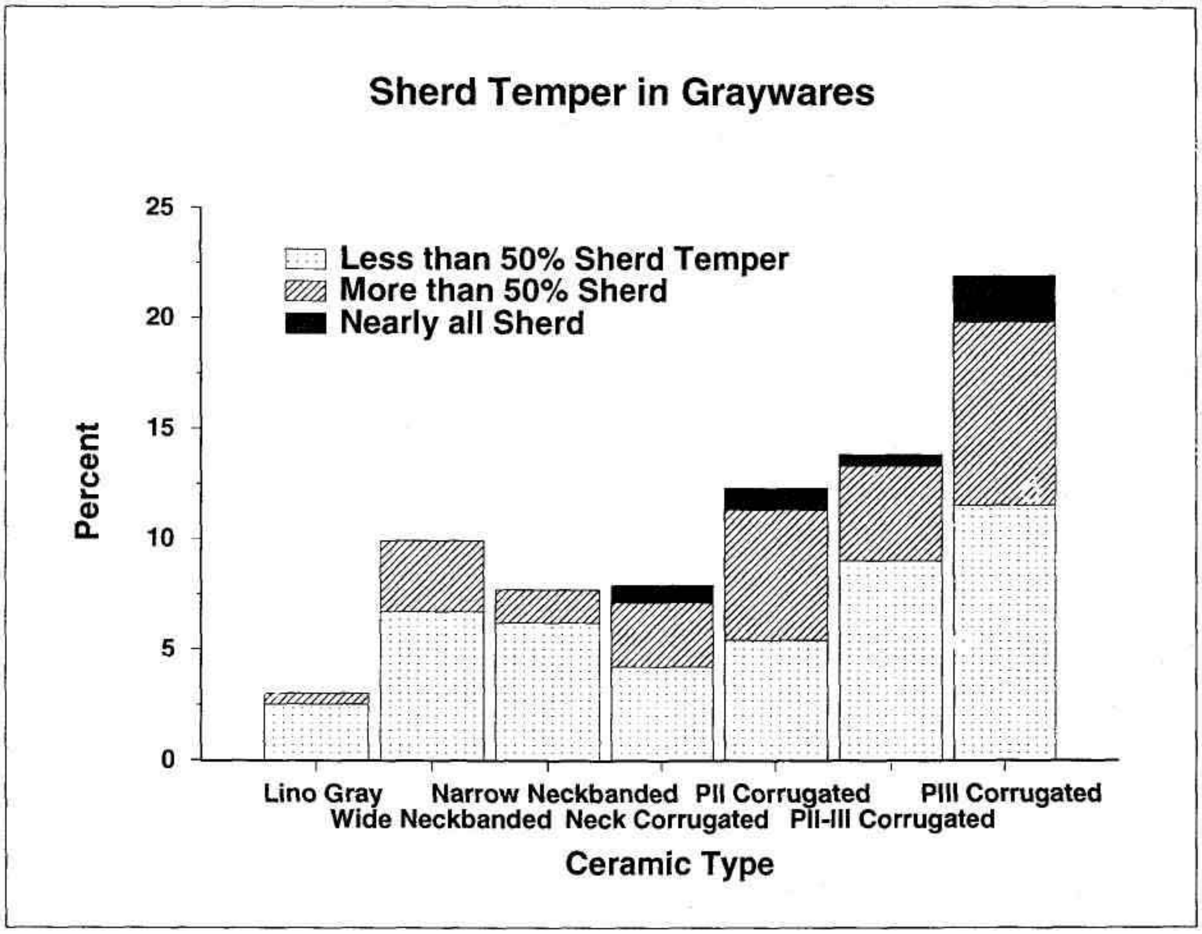


Figure 2.2A. Histogram showing occurrence of sherd temper in graywares. Cases containing no sherd temper are not shown (note difference in grayware and whiteware scales). Sample sizes may be found in Appendix 2A.

by combinations of paste and surface attributes. In order of abundance in the Chaco collection these groups are the San Juan Redwares (Breternitz et al. 1974; Hegmon et al. 1995), the White Mountain Redwares (Carlson 1970), the Tsegi Orangewares, Woodruff Red, and the Chuska Redwares (Peckham and Wilson 1964; Windes 1977). Although these groups are quite readily recognized, the rough sort strategy led to their placement in two groups (decorated redware and plain redware). As discussed in Appendix 2A, it is possible to partially recreate the areal groups based on recorded paste attributes—especially temper. This practice was followed for breakdowns in the type attribute section (Appendix 2A).

Hachure and Chaco

Partly because of the type name, Chaco Black-on-white, hachure is firmly associated with Chaco in many minds. There is a great deal of hachured pottery in Chaco Canyon—30 percent of all painted elements are some form of hachure (Table 2.9)—but to some degree, that occurrence is a function of time as much as a function of space because hachure is a common eleventh and early twelfth century motif (see Toll et al. 1992). Table 2.10 shows all sherds in each type, the sum of all painted design elements within the type, and the percentage of the painted elements that are some form of hachure.

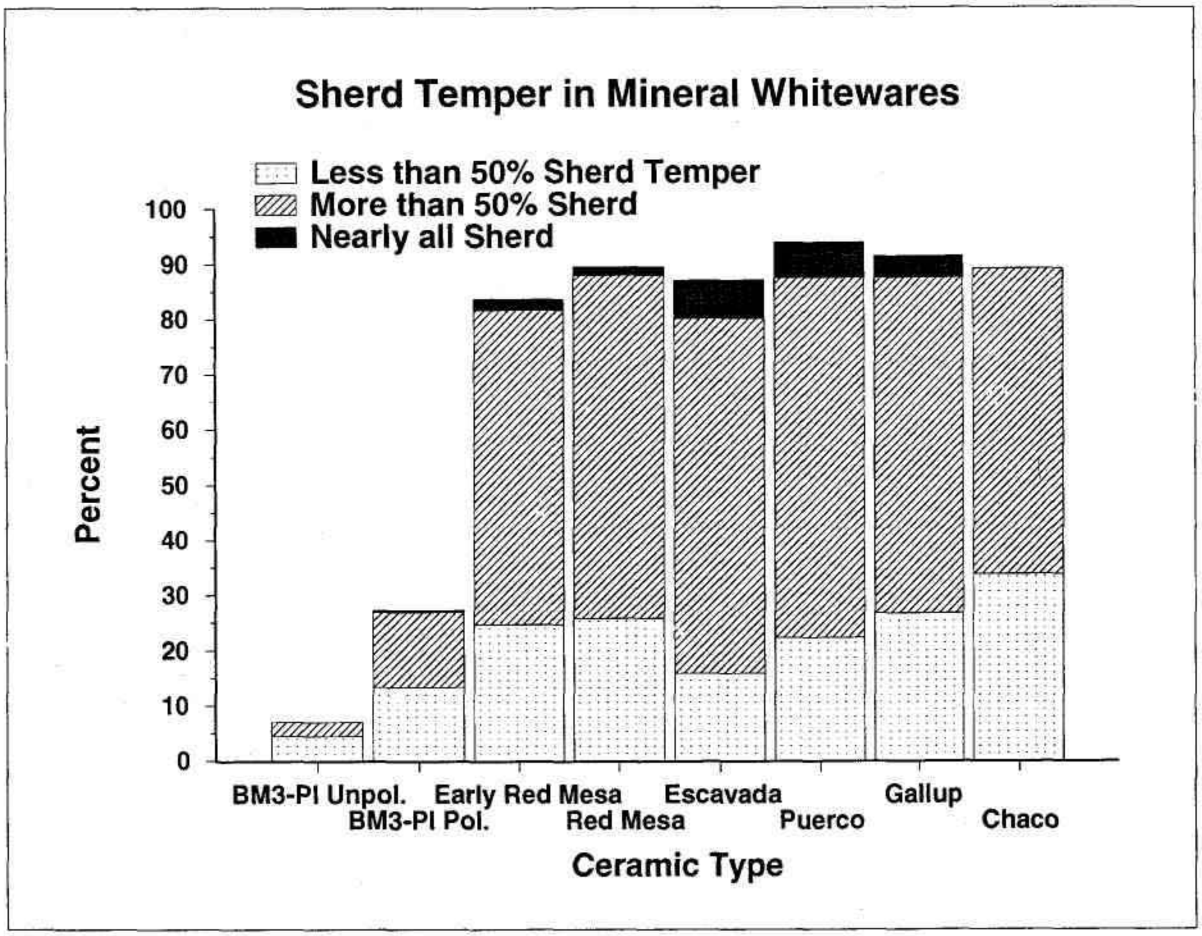


Figure 2.2B. Histogram showing occurrence of sherd temper in mineral-painted whitewares. Cases containing no sherd temper are not shown (note difference in grayware and whiteware scales). Sample sizes may be found in Appendix 2A.

Early development of designs proceeded from isolated designs to designs along continuous lines bisecting or quartering a vessel, then to designs pendant from rims, then to predominately band designs by Red Mesa. Through time, the increasing importance and variety of closed whiteware forms can be seen to contribute to the change from isolated and rim-oriented designs to band designs. Subsequent to Red Mesa, design layouts shift to more complex deployment of designs in decorative fields, concurrent with a florescence in the use of hachure (Figure 2.3).

Hachure is an especially intriguing method of decoration because of its co-occurrence with the Classic Bonito portion of Chacoan prehistory. After scant use in basketry and the earliest painted Anasazi ceramics, the use and varieties of hachure gradually increased through time. In Basketmaker and Pueblo I ceramics, hachure is less than 5 percent of the decoration (Tables 2.10 and 2.11). Hachure in Red Mesa Black-on-white occurs as about 5 to 10 percent of the decoration (Table 2.10; Toll and McKenna 1980, 1987). The aggregate of mineral-on-white types contemporaneous with Gallup Black-on-white

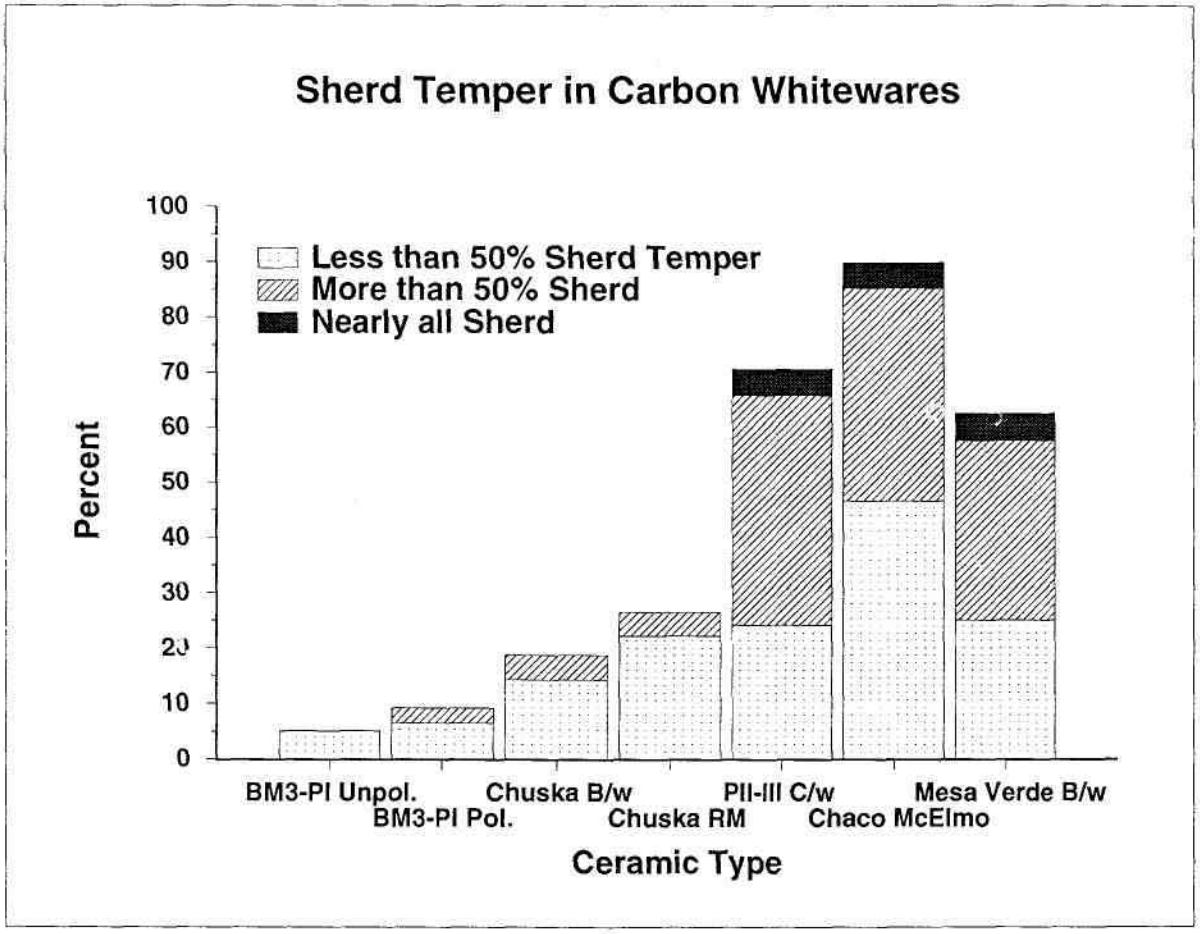


Figure 2.2C. Histogram showing occurrence of sherd temper in carbon-painted whitewares. Cases containing no sherd temper are not shown (note difference in grayware and whiteware scales). Sample sizes may be found in Appendix 2A.

(Puerco-Escavada-Gallup) reaches 58 percent hachured at Pueblo Alto (Toll and McKenna 1987) or 45 percent of all typologically and contextually placed sherds (Table 2.11). All pottery in contexts dating after A.D. 1100 (which contain materials produced earlier as well as vessels by potters continuing to use the previous style) contain less than 20 percent hachure, but Chaco McElmo has nearly none, and Pueblo II-III Carbon-on-white and Mesa Verde Black-on-white exhibit hachure occurrence similar to Red Mesa Black-on-white.

The transition from pottery dominated by Red Mesa Black-on-white designs to pottery dominated by Gallup Black-on-white designs took place at around A.D. 1040. This was a time of great building activity in Chaco Canyon; it marks the first surge of building at a whole new level of labor investment (Lekson 1984a:67, 263). Major building events took place at Chetro Ketl, Pueblo Bonito, and Pueblo Alto. The earliest layers in the Pueblo Alto Trash Mound, which are largely building debris, are associated with Red Mesa Black-on-white and nearly all the trash layers are characterized by Gallup Black-on-white pottery. The heyday of Gallup Black-on-white, from A.D. 1040 to around A.D. 1100, is also the period during which all of the largest building events took place in Chaco Canyon, which further

Table 2.9. Specific hachure element occurrence in primary hachured types. Percent of total painted elements.

Hachure Element	Red Mesa	Chuska Red Mesa	Gallup B/w	Chuska B/w	Chaco B/w	Total No.	% of Hachure
A-1	5.6	21.1	0.4	2.2	-	361	15.1
A-2	0.4	-	1.3	0.7	-	50	2.1
A-3	0.2	-	1.8	3.7	-	55	2.3
B-1	0.2	-	17.0	28.4	2.5	404	16.9
B-2	0.1	-	0.4	1.5	-	15	0.6
B-3	0.1	-	11.4	10.4	-	255	10.7
B-4	0.0	-	21.5	5.2	9.9	462	19.3
B-5	0.0	-	0.3	-	-	8	0.3
B-6	0.1	-	5.4	11.2	-	129	5.4
B-7 Cross-hatched	-	-	0.8	6.7	-	26	1.1
B/C	0.3	0.5	8.0	2.2	3.7	186	7.8
C	-	-	2.0	0.7	74.1	103	4.3
Counterchange	-	-	0.9	-	-	18	0.8
Checkerboard	0.1	-	3.4	0.7	2.5	78	3.3
Band	0.1	-	2.0	1.5	2.5	52	2.2
Heavy Squiggle	0.1	0.5	1.3	2.2	-	36	1.5
Triangles	-	-	0.5	0.7	-	11	0.5
Other	0.2	-	5.9	8.2	-	145	6.1
Total Hachure n	413	42	1,746	116	77	2,394	
Total Motifs n	5,512	189	2,073	134	81	7,989	

strengthens the association of hachure and the Chaco system. This association is analogous to other questions of interpretation regarding Chaco styles and influence. When we see hachured pottery or "Chacoan" architecture at "outliers" or at habitation sites outside the canyon, sometimes at great distance, are we seeing evidence of Chacoan control, a large cooperation sphere, or emulation of a famous place?

The typology employed by the Chaco Project makes type distinctions based on hachure styles (Figure 2.3). Roberts (1927) established a system similar but not completely equivalent to this one. Roberts defines his three hachure types as follows:

Hachure A: "Widely spaced, rather heavy composing lines, either straight or squiggled in tendency; generally although not always the framing lines are rectilinear; a considerable use of solid elements in combination with, or as opposing factors of, the hachured lines.

One of the earliest forms of Hachure A...shows widely spaced, heavy and often squiggled composing lines in association with solid figures." (p. 170)

Hachure B: "The composing lines are still rather widely spaced but the framing lines become quite heavy. This results in a form of the hachured designs which is always pictured as the typical feature of this decoration in the Chaco Canyon. There is to be observed a certain tendency to the survival of the shaded tips...The main outlines of the decoration may be either rectilinear or curvilinear." (pp. 174-175)

Table 2.10. Hachure occurrence as a percentage of total number of recorded painted motifs.

Decorated Type	No. of sherds	No. of motifs	% with hachure
BMIII-PI mineral types	1,059	1,213	4.9
BMIII-PI carbon types	288	318	0.9
Early Red Mesa Black-on-white	397	569	3.7
Red Mesa Black-on-white	3,811	5,507	7.5
Puerco Black-on-white	533	749	1.5
Escavada Black-on-white	212	320	6.3
Gallup Black-on-white	1,672	2,071	83.4
"Puesga" Black-on-white	2,417	3,140	56.0
Chaco Black-on-white	74	81	95.1
Exotic Mineral-on-white	395	581	25.3
Chaco McElmo Black-on-white	91	120	0.8
Red Mesa Design Chuska Black-on-white	129	190	22.1
Chuska Black-on-white	114	134	79.9
PII-III Carbon-on-white	235	282	7.8
Tusayan Whiteware	89	120	0.8
Mesa Verde Black-on-white	42	78	7.7
San Juan Redware	134	167	14.4
Decorated sandstone temper redware	107	149	22.8
Decorated "general" redware	37	48	29.2
Decorated Sanostee Redware	20	24	0.0

Hachure C: "...the chief point of differentiation between the C group and the preceding forms of the hachured designs was in the tendency to make the lines of the decoration vertical and horizontal to the lines of the vessel upon which it was painted. Another feature lies in composing lines which are finer and more closely spaced than in the A and B groups. There are no solid elements in combination with the hachured ones and no shaded tips." (p. 180)

In these definitions the design orientation on the vessel rather than the motif itself is the primary basis for differentiating groups. Roberts saw that oblique, closely-spaced, straight-line hachure between heavier framing lines was later than the heavy, squiggled, and equal width framing and hachure lines. Additionally, there was a reduction through time in the number of vessels with hachured and solid motifs combined. The vessel orientation of Roberts' system is clearly not practical for sherds, and the classification here relies on the relative widths of framing and hachure lines and the spacing of hachure lines. While Roberts recognized and described the design changes used by our typology, the criteria he emphasized are different. Figure 2.3 shows the types of hachure recognized by our analysis and how they relate to Roberts' system, to our types, and to time.

Hachure, as used in Gallup Black-on-white, is known throughout the Anasazi area as "Dogoszhi Style." Although Black Mesa Black-on-white, from the same general area as Dogoszhi Black-on-white, is present in small quantities in the Chaco collection,

Table 2.11. Hachure occurrence by time.

A. Hachure by time group

Time Group (A.D.)	No. of Sherds	No. of Motifs	% with Hachure
Pre-820	587	778	3.6
820-920	312	435	9.2
920-1040	4,650	6,299	13.5
1040-1100	2,102	2,754	44.9
Post-1100	575	767	18.5
TOTAL	8,226	11,033	20.8

B. Hachure type by time group

	Design						Total	
	Hachure A		Hachure B/C		No Hachure			
Time (A.D.)	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Total
500s	-	-	-	-	41	100.0	41	0.5
600s	-	-	-	-	19	100.0	19	0.2
700-820	9	1.8	14	2.8	479	95.4	502	6.3
820-920	31	10.2	7	2.3	266	87.5	304	3.8
829-1020	324	7.1	495	10.9	3,727	82.0	4,546	57.4
1020-1120	51	2.5	1,113	54.7	871	42.8	2,035	25.7
1120-1220	7	1.5	102	22.0	355	76.5	464	5.9
1220-1320	-	-	4	30.8	9	69.2	13	0.2
TOTAL	422		1,735		5,767		7,924	100.0
PERCENT OF TOTAL		5.3		21.9		72.8		

Dogoszhi Black-on-white seems to have been imported very rarely. Powell and Gumerman (1987:86) date this type from A.D. 1050 to 1150, very close to our dates for Gallup Black-on-white, although Oppelt (1988:251) assigns it a later beginning date of A.D. 1085. Goetze and Mills' (1993:49) date of A.D. 1070 to 1180 falls in between. The late A.D. 1000s are when Tsegi Orangewares occur in their highest frequencies in Chaco Canyon, making some occurrence of Dogoszhi Black-on-white in Chaco Canyon seem likely. The virtual absence of Dogoszhi Black-on-white from Chaco Canyon, where it would look so at home, could result from its availability from closer at hand (coals to Newcastle, Dogoszhi to Chaco?); the apparent temporal precedence of more hachure in the Chaco area hints that the Black Mesa area was signing on to the Chaco way of doing things.

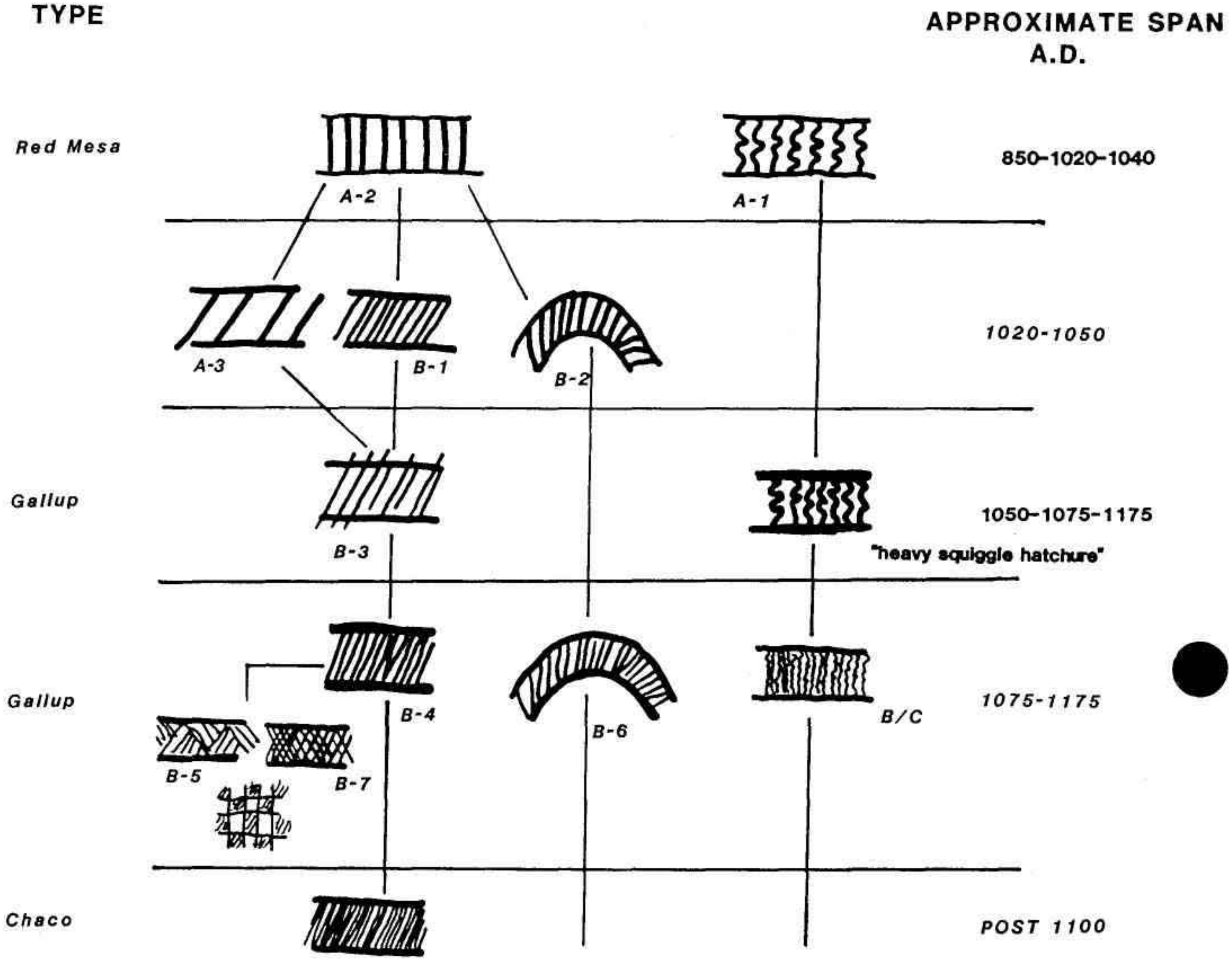


Figure 2.3. *Schematic development and appropriate chronology of hachure development in Chacoan Cibola Whiteware. Hatching lines are both straight and squiggled through time and framing lines are both straight and curvilinear. Filled corner triangles are most common in the A.D. 1020 to 1050 segment.*

There is a clear association of later hachures with closed forms; Hachure A is more likely to be found on ladles, later hachures less likely (Table 2.12). Some of this may result from an increase in closed whiteware forms in later periods, but the association of hachure with closed forms seems real. Windes (1987:114-22) demonstrates a high frequency of jars—mostly Gallup Black-on-white and therefore hachured—on road segments around Pueblo Alto and argues that they were being used for water procurement.

Wilcox (1993:89) suggests that hachured designs and solid designs symbolized one or more dualisms, such as male and female or uncultivated and cultivated. Although an interesting idea, demonstrating the existence of such dualism or which opposition it represented will be very difficult. There are no clearcut associations of one decorative style with particular proveniences that would support this interpretation—both styles occur together (yin must go along with yang?).

Vessel Form Assemblages

Tables 2.13, 2.14, and 2.15 provide information on the distribution of vessel forms by site, type, and time segment (Figure 2.4). The following form descriptions draw from standard practice, observation, and Rice (1987), and define the set of forms recorded by the Chaco Project analysis. With the exception of a few "kicked up" bases on ollas and pitchers (where a round concavity is created by pushing the base toward the vessel interior during forming), and the flat bases of mugs and cylinder jars, nearly all vessels from this multi-century period have rounded bases. This avoidance of angled corners would reduce vessel cracking during drying and firing. Until late in the series when rims become thicker and squared off, there is also little variation in the rim profiles, rims being rounded and simple.

Open Forms

Bowl

This simple form predominates most of the white, red, and polished smudged wares, and was probably the most abundant of all forms. With this great abundance, there is a great range of sizes (Figure 2.5); thus, variation in uses, the most common one probably being service of food. Although some classifications include very deep forms with restricted orifices as bowls (see Rice 1987:216), it is rare for bowls in this assemblage to constitute more than half a sphere or for there to be any incurvature at the rim, a trait more common in post-Pueblo III bowls. That is, the greatest diameter of the vessel is at the rim in the great majority of bowls in this assemblage. The average estimated diameter of all whiteware bowls is 19.0 cm, with a standard deviation of 6.0 cm (range from 2 cm to 36 cm, 5,500 cases).

Most bowls in this assemblage are plain on the exterior with varying degrees of polish and slip being the only exterior treatment. A minority of vessels, however, has further exterior embellishment in the form of fugitive red wash, surface texturing, or painted design. The most common form of texturing is corrugation, which may be more common in other Anasazi regions than in Chaco—the highest percentages of types with exterior corrugation are polished smudged and exotic mineral-on-white (Table 2.16A). Although Peckham (1990:50) attributes exterior bowl corrugation especially to Pueblo II, it occurs in similar low frequencies in the common types ranging into early Pueblo III in this assemblage. Increasingly elaborate painted exterior motifs occur on bowls in the A.D. 1200s; later Mesa Verde Black-on-white and, by definition, St. Johns Polychrome are characterized by motifs on bowl exteriors (see Cattanach 1980; Rohn 1971:170-172; Toll et al. 1980). Before then, however, simpler, less extensive exterior painted designs are present but not common (Table 2.16B). Windes (1984b:104) suggests that these may be vessel ownership marks; they could also be producers' marks (see Huse 1976), but they are too rare to establish any patterns. Even less common than painted designs, but still present, are vessels on which slip has been used to make a simple figure such as broad circles or stripes. The use of red ocher fugitive red wash on bowl exteriors occurred primarily in the A.D. 600s and 700s, primarily in the Basketmaker III-Pueblo I decorated types with both carbon and mineral paints (see also Roberts 1929:110-111), but with carbon-painted types having higher percentages. The frequencies of fugitive red recorded in the Chaco assemblage are much higher than those recorded by the Dolores Project in comparable time segments; Errickson (1988) reports maximum occurrence of around 2 percent, while we recorded over 20 percent (Table 2.17A). While fugitive red was clearly an early practice, it continues to appear on later specimens at a rate of around one percent.

Table 2.12. Forms by hachure type.

	Design							
	Hachure A		Hachure B/C		No Hachure		Total	
Grouped Forms	No.	% of Design	No.	% of Design	No.	% of Design	No.	% of Total
Bowl	382	65.5	1,324	59.1	5,652	69.0	7,358	66.8
Ladle	60	10.3	142	6.3	804	9.8	1,006	9.1
Closed	141	24.2	773	34.5	1,733	21.2	2,647	24.0
TOTAL	583		2,239		8,189		11,011	100.0
PERCENT OF TOTAL		5.3		20.3		74.4		

$\chi^2=180.61016$ df=4 p=.00000 c=.127

Ladle

This form includes three different codes: ladle sherd with handle portion, ladle portion with complete handle tip, and bowl sherds less than 20 cm in diameter with "dipper wear" on the rim. This form of wear results in a bevel away from the interior of the ladle bowl with a rounded outer edge and sharper inner edge, and is present on most ladles. Ladles in Chaco Canyon come in two basic forms. Earlier, they are so-called gourd or trough dippers, in which the handle and the bowl are a continuous compartment, indeed looking like a portion of a gourd (see Figures 2.4, 2A.10; Toll and McKenna 1992:217). The earliest ladles, in which the "gourd neck" is not cut away (see Hayes and Lancaster 1975:102), are rare or absent in this assemblage. Later (starting in Pueblo II), the ladle form changes to a discrete bowl with a round (often tubular) or flat handle affixed (see Rohn 1971:173-175). The gourd type of handle outnumbers tubular handles in the A.D. 1040 to 1100 period, but after A.D. 1100, it is less common than the tubular variety (Table 2.18). Though the distinction was not coded, it would have been preferable to have separate codes for the gourd and bowl-and-handle varieties of ladle; the distinction can be mostly recreated by tabulation of handle form by vessel form. We did not record handle lengths (there were very few intact ones), but most are in the range of 15 to 20 cm; Judd (1959:154, Plate 26) recovered "two perfectly absurd ladles" with handles 37 cm long from Pueblo del Arroyo.

Closed Forms

Jar

This name is applied to all closed forms that cannot be placed in one of the more specific forms below. Graywares are nearly all closed forms, and most variation in them is in size. Whiteware closed forms are more differentiated, and in dealing with sherds, it is necessary to have particular portions of a vessel to determine from what kind of closed form the sherd came. "Jar" in the decorated wares, then, include generic closed form sherds, as well as vessels that are generally medium in size (larger examples being ollas, smaller ones pitchers, seed jars, or canteens), and have restricted but not very small, orifices with necks (see Peckham 1990:37, 60 for vessels we would have called jars). Although "jar" is one of the most common whiteware categories in sherd counts, whole vessel examples of jars do not seem to occur in similar frequencies; jars are perhaps more often found in historic or modern pueblo assemblages. When vessels are complete it is more often possible to place them in a vessel category not identifiable from sherds.

Gray jars have been separated from white jars by means of a permanent recode. The great majority of graywares are called jars. Exceptions are smaller vessels with vertical handles which were coded as pitchers. Gray jars have a large size range, from small vessels with volumes of less than a liter to huge

Table 2.13. Detailed analysis distribution of vessel forms by site.

							Jar										
Site	Bowl	Ladle	Canteen	Pitcher	Seed Jar[a]	Tecomate	No.	Gray	White	Red	Olla	Duck Pot	Effigy	Miniat./ Exot.[b]	Unk.	Total	% Total
29SJ 299-BMIII	134	-	1	5	-	29	314	303	11	-	10	-	-	-	8	501	2.5
row %	26.7	-	0.2	1.0	-	5.9	62.7	-	-	-	2.0	-	-	-	1.6	-	-
29SJ 423	196	1	-	-	-	60	336	295	3	38	13	-	-	-	31	637	3.2
row %	30.8	0.2	-	-	-	9.4	52.7	-	-	-	2.0	-	-	-	4.9	-	-
29SJ 1659	50	-	-	1	-	16	111	107	4	-	12	-	-	3	2	195	1.0
row %	25.6	-	-	0.5	-	8.2	56.9	-	-	-	6.2	-	-	1.5	1.0	-	-
29SJ 628	430	1	1	6	-	150	242	227	13	2	14	-	-	8	15	867	4.3
row %	49.6	0.1	0.1	0.7	-	17.3	27.9	-	-	-	1.6	-	-	0.9	1.7	-	-
29SJ 299-PI	49	3	-	-	-	10	181	144	37	-	1	-	-	-	3	247	1.2
row %	19.9	1.2	-	-	-	4.0	73.3	-	-	-	0.4	-	-	-	1.2	-	-
29SJ 724	296	3	-	1	-	50	183	141	33	9	2	-	-	-	8	543	2.7
row %	54.5	0.6	-	0.2	-	9.2	33.7	-	-	-	0.4	-	-	-	1.5	-	-
29SJ 721	72	-	-	-	-	13	55	47	8	-	1	-	-	-	2	143	0.7
row %	50.3	-	-	-	-	9.1	38.5	-	-	-	0.7	-	-	-	1.4	-	-
29SJ 629	821	103	15	29	10	12	625	290	328	7	44	2	6	7	32	1,706	8.5
row %	48.1	6.0	0.9	1.7	0.6	0.7	36.6	-	-	-	2.6	0.2	0.4	0.4	1.9	-	-
29SJ 1360	986	146	11	75	18	29	691	382	306	3	65	5	8	11	43	2,088	10.4
row %	47.2	7.0	0.5	3.6	0.8	1.4	33.1	-	-	-	3.1	0.2	0.4	0.5	2.1	-	-
29SJ 627	3,663	606	49	241	51	118	2,332	1,580	745	7	184	14	27	24	205	7,517	37.3
row %	48.7	8.1	0.7	3.2	0.7	1.6	31.0	-			2.4	0.2	0.4	0.3	2.7	-	-
Pueblo Alto	2,249	270	23	177	32	23	2,426	1,915	506	5	155	2	-	15	6	5,378	26.7
row %	41.8	5.0	0.4	3.3	0.6	0.4	45.1	-	-	-	2.9	-	-	0.3	0.1	-	-
29SJ 633	168	18	2	4	1	4	112	86	26	-	2	2	2	1	2	318	1.6
row %	52.8	5.7	0.6	1.3	0.3	1.3	35.2	-	-	-	0.6	0.6	0.6	0.3	0.6	-	-
TOTAL	9,114	1,151	102	539	112	514	7,608	-	-	-	503	25	43	72	357	20,140	-
% of Total	45.2	5.7	0.5	2.7	0.6	2.5	37.8	-	-	-	2.5	0.1	0.2	0.4	1.8	-	100.0

[a] Includes 19 gourd jars as follows: 29SJ 629 = 5, 29SJ 1360 = 11, 29SJ 627 = 2, Pueblo Alto = 1.

[b] Includes 14 pipes as follows: 29SJ 1659 = 3, 29SJ 628 = 8, 29SJ 627 = 3.

Table 2.13. (continued)

	Diversity Index		
Site	H'	J	s
29SJ 299-BMIII	0.946	0.528	6
29SJ 423	1.014	0.630	5
29SJ 1659	1.139	0.636	6
29SJ 628	1.170	0.563	8
29SJ 299-PI	0.751	0.467	5
29SJ 724	0.978	0.546	6
29SJ 721	0.965	0.696	4
29SJ 619	1.218	0.490	12
29SJ 1360	1.338	0.539	12
29SJ 627	1.313	0.511	13
Pueblo Alto	1.186	0.495	11
29SJ 633	1.142	0.476	11
Composite Index	1.279	0.499	13

vessels holding over 20 liters (Table 2.20; Figure 2.6). Since they tended to be large, they experienced use that was likely to break them; because they were such an important part of the vessel assemblage, sherds from gray jars make up the majority of most bulk collections (Table 2.1). Surface treatment of gray jars went through a series of distinct and very archeologically useful changes (see Appendix 2A; Figure 2.4); the earliest vessels were mostly just scraped smooth, although there is a subset that was polished. A progressive sequence of texturing the "necks" (approximately the upper third of the vessel, the straight-sided portion above the more or less spherical portion body) of gray vessels followed, first with wider bands left visible, then narrower, then indented corrugations, all with smoothed lower portions of the vessel. Beginning in the late A.D. 900s, potters produced vessels, the entire exteriors of which were indented corrugated. This practice continued through the end of the temporal span covered by this collection and accounts for the greatest number of gray vessels. As is true in whitewares, application of fugitive red wash to grayware vessel exteriors was a common practice in the A.D. 600s and 700s, but was nearly completely abandoned by the time neckbanding began to be used (Table 2.17A, B). Whereas whiteware jars were rarely colored with fugitive red, around half of the closed forms in Lino Gray and Fugitive Red combined have this treatment (Table 2.17B).

Olla

This form includes large to extremely large vessels with small, usually vertical necks. Our usage of the term is idiosyncratic; we include only large vessels with markedly restricted orifices (Figure 2.7), while "olla" in other analyses includes vessels with much wider orifices, in accord with the dictionary definition of the term (e.g. Peckham 1990:112-116).

Table 2.14 Distribution of vessel forms by types for detailed analysis sample.

A. Rough sort type

Type	Bowl	Ladle	Canteen	Pitcher	Gourd Jar	Seed Jar	Teco-mate	Jar	Olla	Pipe	Duck Pot	Effigy	Miniat./ Exotics[a]	Un-known	Total
Plain Gray	11	6	-	19	-	-	-	647	-	-	-	2	1	79	765
Lino Gray	13	-	4	9	-	1	366	213	32	1	-	-	-	14	653
Lino Fugitive Red	1	-	1	5	-	-	1	174	19	-	-	-	-	5	206
Obelisk Gray	16	-	-	-	-	-	55	433	3	4	-	-	-	24	535
Wide Neckbanded	-	-	-	1	-	-	-	298	-	-	-	-	-	-	299
Narrow Neckbanded	1	-	-	8	-	-	-	651	-	-	-	-	1	-	661
Neck Corrugated	-	-	-	2	-	-	-	244	1	-	-	-	-	-	247
PII Corrugated	-	-	-	6	-	-	-	1,022	-	-	-	-	2	-	1,030
PII-III Corrugated	-	-	-	-	-	-	-	225	1	-	-	-	2	-	228
PIII Corrugated	-	-	-	1	-	-	-	103	-	-	-	-	-	-	104
Unident. Corrugated	-	-	-	1	-	-	-	1,445	-	-	-	-	-	-	1,446
GRAYWARE TOTAL	42	6	5	52	-	1	422	5,455	56	5	-	2	6	122	6,175
Percent of ware	0.7	0.1	0.1	0.8	-	-	6.9	88.3	0.9	0.1	-	-	0.1	2.0	-
BMIII-PI Polished	516	1	-	2	1	2	5	49	-	-	-	-	-	1	589
BMIII-PI Unpolished	389	3	-	4	-	-	12	58	1	-	2	-	-	1	470
Early Red Mesa B/w	315	19	2	6	2	1	-	46	5	-	1	-	-	-	397
Red Mesa B/w	2,703	408	15	89	5	33	12	415	75	1	9	11	10	25	3,811
Escavada B/w	155	23	-	13	-	4	1	10	5	-	-	1	-	-	212
Puerco B/w	330	78	5	20	-	3	2	74	15	-	-	2	1	3	533
Gallup B/w	983	100	8	154	-	18	15	330	49	-	2	1	8	4	1,672
Chaco B/w	22	1	1	20	-	-	1	26	2	-	-	-	1	-	74
Exotic M/w	252	34	5	6	3	1	1	88	4	-	1	-	-	-	395
PII-III M/w	1,221	267	38	79	4	14	14	503	205	2	5	16	19	81	2,468
MINERAL-ON-WHITE	6,886	946	74	393	15	76	63	1,599	361	3	20	31	39	115	10,619
Percent of ware	64.8	8.9	0.7	3.7	0.1	0.7	0.6	15.1	3.4	-	0.2	0.3	0.4	1.1	-
BMIII-PI Polished C/w	149	3	-	6	1	-	-	29	-	-	-	1	-	-	189
BMIII-PI Unpolished C/w	92	-	-	-	-	-	-	6	-	-	-	-	-	1	99
Chuska, Red Mesa design	66	21	1	14	-	-	-	23	-	-	-	-	1	2	129
Chuska B/w	76	13	-	4	-	-	1	17	3	-	-	-	-	-	114
Chuska C/w	140	42	1	13	1	-	1	22	17	-	2	1	1	3	244
Tusayan C/w	85	2	1	-	-	1	-	-	-	-	-	-	-	-	89
Chaco-McElmo B/w	62	3	1	14	-	-	-	9	2	-	-	-	-	-	91
PII-III C/w	168	19	4	6	-	-	-	24	8	-	-	1	2	3	235
Mesa Verde B/w	34	4	1	-	-	-	-	-	2	-	-	-	1	-	42
CARBON-ON-WHITE	872	107	9	57	2	1	2	130	33	-	2	3	5	9	1,232
Percent of ware	70.8	8.7	0.7	4.6	0.2	0.1	0.2	10.6	2.7	-	0.2	0.2	0.4	0.7	-

Table 2.14. *(continued)*

Type	Bowl	Ladle	Canteen	Pitcher	Gourd Jar	Seed Jar	Teco-mate	Jar	Olla	Pipe	Duck Pot	Effigy	Miniat./ Exotics[a]	Un-known	Total
Unident. Whiteware	520	85	13	32	1	6	14	290	53	-	2	4	5	98	1,124
WHITEWARE TOTAL	8,278	1,138	96	482	18	83	79	2,020	447	3	24	38	49	220	12,975
Percent of ware	63.8	8.8	0.7	3.7	0.1	0.6	0.6	15.6	3.5	-	0.2	0.3	0.4	1.7	-
REDWARE TOTAL[b]	392	5	1	4	-	9	11	72	1	-	1	2	-	7	505[b]
Percent of ware	77.6	1.0	0.2	0.8	-	1.8	2.2	14.3	0.2	-	0.2	0.4	-	1.4	-
Polished Smudged	376	2	-	1	-	-	-	11	-	-	-	-	-	1	391
Brownware	17	-	-	-	-	-	1	47	1	-	1	1	1	6	75
Mudware	6	-	-	-	-	-	-	-	-	6	-	-	-	-	12
GRAND TOTAL	9,111[c]	1,151	102	539	18	93	514	7,604	505	14	26	43	56	359	20,133
PERCENT	45.3	5.7	0.5	2.7	0.1	0.5	2.6	37.8	2.5	0.1	0.1	0.2	0.3	1.8	-

[a] Exotics are mugs 4, cylinder jars 2, miniature forms 50.

[b] Includes 8 polychromes and 127 plain red.

[c] Excludes 2 Navajo bowls.

B. Form percentages in major decorated types

Type	No.	Percent Bowl	Ladle	Jar	Pitcher	Olla	Other Closed[a]
BMIII-PI Mineral	1,059	85.5	0.4	10.1	0.6	0.1	2.1
BMIII-PI Carbon	288	83.7	1.0	12.2	2.1	-	0.3
Early Red Mesa	397	79.3	4.8	11.6	1.5	1.2	1.5
Red Mesa	3,811	70.9	10.7	10.9	2.3	2.0	1.9
Chuska Red Mesa	129	51.2	16.3	17.8	10.9	0.8	0.8
Puerco-Escavada	745	65.1	13.6	11.3	4.4	2.7	2.0
Gallup	1,670	58.9	6.0	19.8	9.2	2.9	2.6
Chuska B/w	114	66.7	11.4	14.9	3.5	2.6	0.9
Chaco B/w	74	29.7	1.4	35.1	27.0	2.7	2.7
Chaco McElmo	91	68.1	3.3	9.9	15.4	2.2	1.1
PII-III Carbon	235	71.5	8.1	10.2	2.5	3.4	1.7
Decorated red and polychrome	378	85.7	0.5	6.9	1.1	-	4.0
All red and white types	13,481	64.2	8.5	15.5	3.6	3.3	2.4

[a] Canteen, d[illegible], tecomate, seed jar.

Table 2.15. *Chaco forms by time group.*

	Time									
	500s		600s		700-820		820-920		920-1040	
Vessel Form[a]	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time
Utility Jars:										
Gray Jar	244	40.5	103	54.2	523	34.1	94	20.2	1,409	20.5
GW Pitcher	-	-	1	0.5	9	0.6	2	0.4	22	0.3
GW Tecomate	54	9.0	16	8.4	153	10.0	5	1.1	79	1.2
Brown Jar	51	8.5	2	1.1	-	-	-	-	-	-
Bowls and Ladles:										
GW Bowl	8	1.3	8	4.2	10	0.7	2	0.4	6	0.1
White Bowl	106	17.6	33	17.4	562	36.7	228	49.0	3,299	48.1
RW Bowl	42	7.0	1	0.5	41	2.7	9	1.9	96	1.4
PS Bowl	22	3.7	7	3.7	80	5.2	3	0.6	68	1.0
Brown Bowl	16	2.7	-	-	-	-	-	-	-	-
GW Ladle	1	0.2	-	-	1	0.1	-	-	4	0.1
WW Ladle	-	-	-	-	13	0.8	28	6.0	483	7.0
RW Ladle	-	-	-	-	-	-	-	-	3	0.0
Brown Ladle	-	-	-	-	-	-	-	-	-	-
Decorated Jars:										
GW Olla	11	1.8	12	6.3	13	0.8	1	0.2	2	0.0
WW Jar	3	0.5	4	2.1	83	5.4	65	14.0	846	12.3
WW Olla	-	-	-	-	2	0.1	12	2.6	176	2.6
RW Olla	4	0.7	-	-	-	-	-	-	-	-
Brown Olla	1	0.2	-	-	-	-	-	-	-	-
WW Tecomate	1	0.2	-	-	11	0.7	1	0.2	22	0.3
Brown Tecomate	1	0.2	-	-	-	-	-	-	-	-
WW Pitcher	-	-	-	-	3	0.2	8	1.7	175	2.5
RW Pitcher	-	-	-	-	-	-	1	0.2	-	-
GW Canteen	-	-	-	-	1	0.1	1	0.2	2	0.0
WW Canteen	-	-	-	-	1	0.1	1	0.2	49	0.7
WW Duck Pot	-	-	-	-	1	0.1	1	0.2	9	0.1
Mug	-	-	-	-	-	-	-	-	2	0.0
WW Seed Jar	-	-	-	-	2	0.1	-	-	40	0.6
Gourd Jar	-	-	-	-	1	0.1	-	-	13	0.2

Table 2.15 *(continued)*

	Time							
	1040-1100		1100-1220		1200-1320		Total	
Vessel Form[a]	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time
Utility Jars:								
Gray Jar	1,435	38.5	219	27.2	8	34.8	4,035	28.4
GW Pitcher	3	0.1	-	-	-	-	37	0.3
GW Tecomate	1	0.0	-	-	-	-	308	2.2
Brown Jar	1	0.0	1	0.1	-	-	55	0.4
Bowls and Ladles:								
GW Bowl	-	-	-	-	-	-	34	0.2
WW Bowl	1,304	35.0	326	40.5	8	34.8	5,866	41.3
RW Bowl	55	1.5	52	6.5	-	-	296	2.1
PS Bowl	84	2.3	31	3.9	-	-	295	2.1
Brown Bowl	-	-	1	0.1	-	-	17	0.1
GW Ladle	-	-	-	-	-	-	6	0.0
WW Ladle	180	4.8	41	5.1	4	17.4	749	5.3
RW Ladle	-	-	-	-	-	-	3	0.0
Brown Ladle	1	0.0	1	0.0	-	-	2	0.0
Decorated Jars:								
WW Jar	360	9.7	48	6.0	1	4.3	1,410	9.9
GW Olla	-	-	-	-	-	-	39	0.3
RW Olla	1	0.0	-	-	-	-	1	0.0
WW Olla	114	3.1	24	3.0	-	-	368	2.6
Brown Olla	-	-	-	-	-	-	1	0.0
WW Tecomate	17	0.5	4	0.5	1	4.3	57	0.4
Brown Tecomate	-	-	-	-	-	-	1	0.0
WW Pitcher	116	3.1	39	4.8	1	4.3	343	2.4
RW Pitcher	2	0.1	-	-	-	-	3	0.0
GW Canteen	-	-	-	-	-	-	4	0.0
WW Canteen	15	0.4	3	0.4	-	-	69	0.5
Duck Pot	-	-	1	0.1	-	-	12	0.1
Mug	1	0.0	-	-	-	-	3	0.0
WW Seed Jar	22	0.6	4	0.5	-	-	67	0.5
Gourd Jar	1	0.0	-	-	-	-	15	0.1
RW Jar	2	0.1	1	0.1	-	-	61	0.4
RW Canteen	1	0.0	-	-	-	-	1	0.0

Table 2.15 (continued)

	Time									
	500s		600s		700-820		820-920		920-1040	
Vessel Form[a]	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time
RW Jar	37	6.1	-	-	11	0.7	-	-	10	0.1
RW Canteen	-	-	-	-	-	-	-	-	-	-
RW Seed Jar	-	-	-	-	-	-	-	-	1	0.0
RW Tecomate	3	0.5	-	-	2	0.1	-	-	1	0.0
RW Duck Pot	-	-	-	-	-	-	-	-	1	0.0
Miniature Vessel	-	-	-	-	2	0.1	-	-	15	0.2
Effigy	-	-	-	-	-	-	3	0.6	30	0.4
Pipe	-	-	3	1.6	8	0.5	-	-	-	-
TOTAL	602	100.0	190	100.0	1,533	100.0	465	100.0	6,863	100.0

	Time							
	1040-1100		1100-1220		1200-1320		Total	
Vessel Form[a]	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time
RW Seed Jar	1	0.0	3	0.4	-	-	5	0.0
RW Tecomate	1	0.0	-	-	-	-	7	0.0
RW Duck Pot	-	-	-	-	-	-	1	0.0
Miniature Vessel	6	0.2	6	0.7	-	-	29	0.2
Effigy	-	-	-	-	-	-	31	0.2
Pipe	-	-	-	-	-	-	11	0.1
TOTAL	3,723	100.0	805	100.0	23	100.0	14,204	100.0

[a] Key: GW = grayware WW = whiteware RW = redware PS = polished smudged

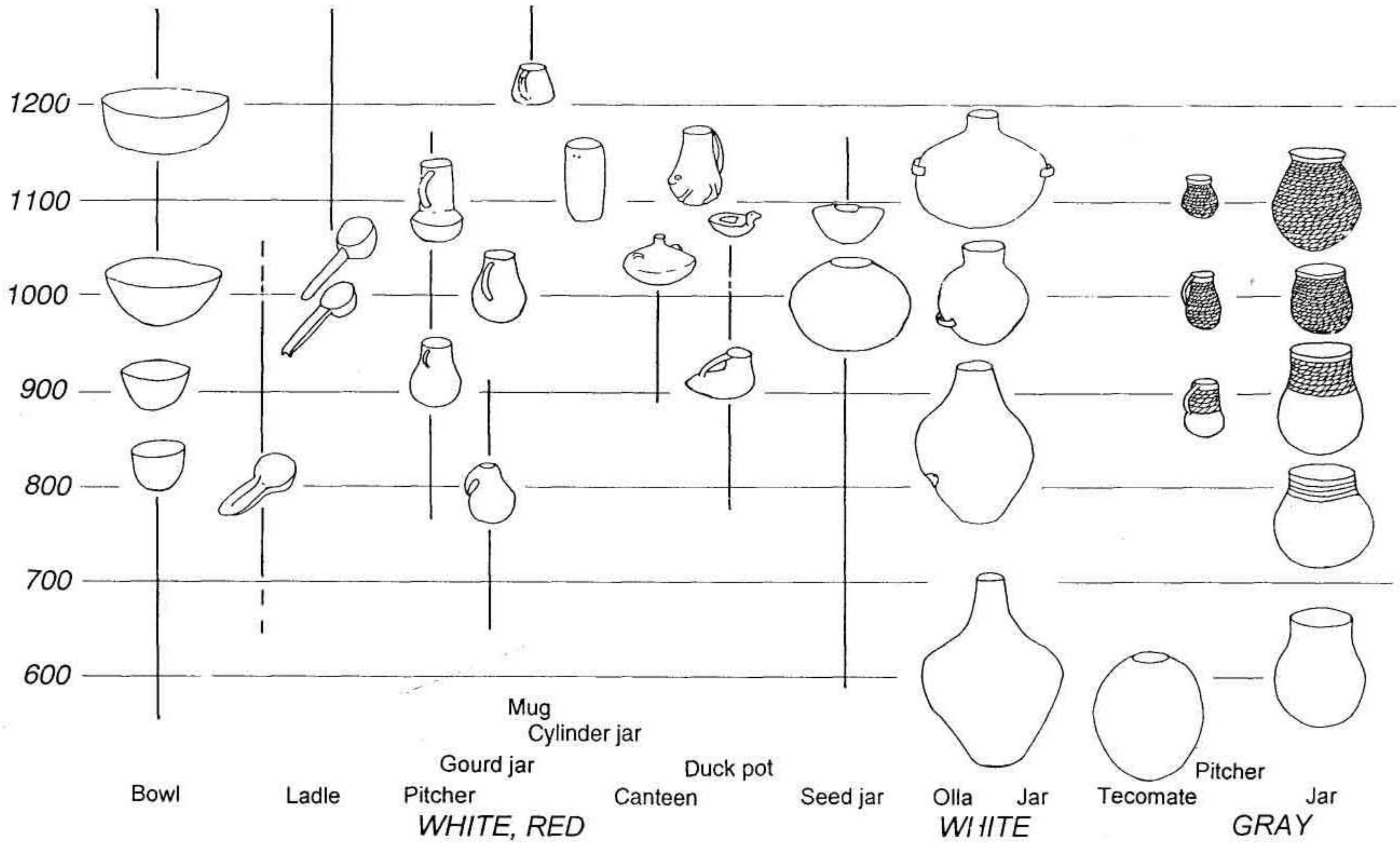


Figure 2.4. Vessel form outlines with approximate use spans; most common ware types of forms at bottom.

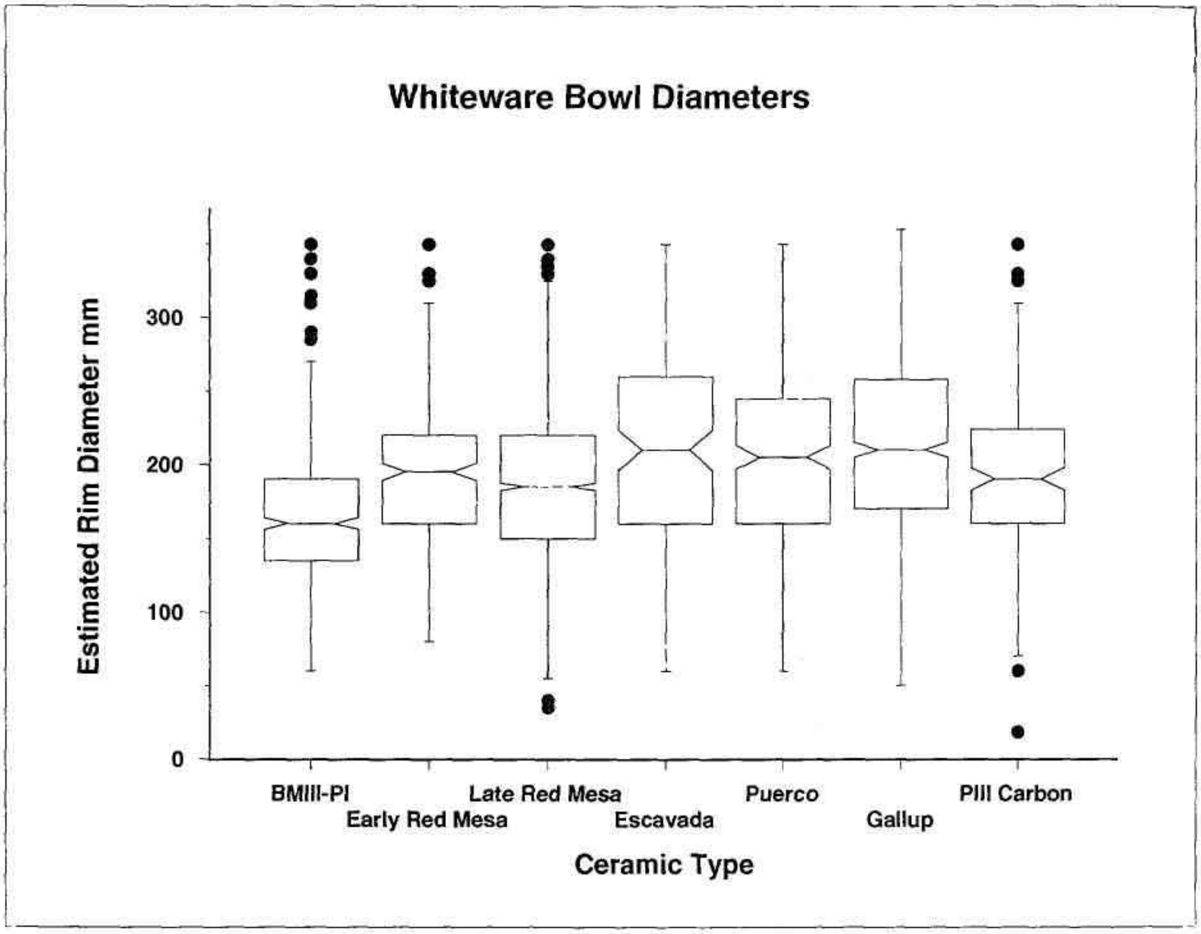


Figure 2.5. Box plot of whiteware bowls. Sample is composed as follows:

Basketmaker III-Pueblo I	*505*
Early Red Mesa	*261*
Late Red Mesa	*2,064*
Escavada	*129*
Puerco	*272*
Gallup	*732*
Pueblo III Carbon	*175*
Total	*4,138*

All carbon and mineral paint Basketmaker III-Pueblo I types included as a single group. Pueblo III carbon includes Pueblo II-PIII Carbon-on-white and Chaco McElmo Black-on-white. In notched box plots the box top and bottom lines represent the interquartile range (25 to 75 percent), the line within the box is at the median; if the notches of the two boxes do not overlap, there is a 95 percent chance that the samples are different on the measurement in question (Chambers et al. 1983:60-63). Range of values is shown by lines outside boxes, extremes and [statistical] outliers are plotted individually.

Table 2.16. Exterior decoration on bowls.

A. Bowls with textured exteriors

Type	Wide Bands and Clapboard	Narrow Bands and Clapboard	Narrow Corrugated	Wide Corrugated	Modified Corrugated	Total	Percent of Total Bowls
BMIII-PI Polished M/w	1	-	-	-	-	1	0.2
Late Red Mesa B/w	3	4	1	-	-	8	0.3
Escavada B/w	-	-	1	1	-	2	1.3
Puerco B/w	-	-	1	1	1	3	0.9
Gallup B/w	-	2	2	4	1	9	0.9
PII-III M/w	1	4	4	-	-	9	0.7
Chuska Red Mesa B/w	-	1	-	-	-	1	1.5
Chaco McElmo B/w	-	-	1	-	-	1	1.6
Plain Whiteware	3	1	3	-	-	7	1.3
Exotic M/w	-	1	2	2	-	5	2.0
Decorated Redware	-	-	1	-	-	1	0.3
Exotic Brownware	-	-	1	-	-	1	5.9
Polished Smudged	-	1	10	-	1	12	3.2
TOTAL	8	14	27	8	3	60	7.0

B. Exterior designs in paint and slip (sometimes called ownership marks)

Type	Painted	Slip	Total	Percent of Total Type
BMIII-PI Unpolished M/w	6	-	6	1.3
BMIII-PI Polished M/w	6	-	6	1.0
Early Red Mesa	2	-	2	0.5
Red Mesa	41	-	41	1.1
Escavada	2	1	3	1.4
Puerco	17	2	19	3.6
Gallup	31	5*	36	2.2
Chaco Black-on-white	1	-	1	1.4
Exotic Mineral-on-white	10	-	10	2.5
PII-III Mineral-on-white	18	1	19	0.8
BMIII-PI Polished Carbon	1	-	1	0.5
PII-III Carbon-on-white	4	-	4	1.7
Mesa Verde Black-on-white	15	-	15	35.7
Chuska Black-on-white	2	-	2	1.8
Chuska Whiteware	1	-	1	0.4
Unidentified Whiteware	1	2	3	0.3
Decorated Redware	2	-	2	0.5
Polychrome Redware	-	4	4	50.0
TOTAL	160	15	175	1.3

* One specimen has both painted and slip exterior designs.
Percent in the totals row is taken from 13,354 red and whitewares.

Table 2.17. Occurrence of fugitive red.

A. Fugitive red occurrence by ware and time group

	Time Group													
	500s		600s		700-820		820-920		920-1040		1040-1100		Total	
Ware	No.	% Ware-time	No.	% Ware-time	No.	% Ware-time	No.	% Ware-time	No.	% Ware-time	No.	% Ware-time	No.	% Ware
Grayware	9	2.7	33	22.8	143	19.4	4	3.6	20	1.3	1	0.1	210	4.6
Mineral-on-white	7	15.2	5	16.7	135	27.6	6	2.0	52	1.1	16	0.8	221	2.9
Carbon-on-white	-	-	-	-	65	57.5	-	-	2	0.7	1	0.6	68	8.0
TOTAL	16	4.1	38	21.6	343	25.6	10	2.3	74	1.2	18	0.5	499	3.9

Percents of total do not include red and brownwares.

B. Occurrence of fugitive red by type and vessel form

	Vessel Form													
Type	Bowl		Ladle		Jar		Olla		Other closed		Other		Total	
	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type
Lino Gray+Fugitive	1	7.1	-	-	191	49.4	22	53.7	16	4.1	5	26.3	235	27.4
Polished Tan Gray	2	12.5	-	-	38	8.8	-	-	2	3.6	-	-	42	7.8
Wide Neckbanded	-	-	-	-	1	0.3	-	-	-	-	-	-	1	0.3
Narrow Neckbanded	1	100.0	-	-	-	-	-	-	-	-	-	-	1	0.2
Neck Corrugated	-	-	-	-	1	0.4	-	-	-	-	-	-	1	0.4
Unidentified Plain	1	9.1	-	-	63	9.7	-	-	1	5.3	3	3.7	68	8.9
Unidentified Corrugated	-	-	-	-	1	0.1	-	-	-	-	-	-	1	0.1
BMIII-PI Unpolished M/w	124	31.9	1	7.7	1	1.7	-	-	-	-	-	-	126	26.8
BMIII-PI Polished M/w	108	20.9	-	-	3	6.1	-	-	-	-	-	-	111	18.8
Early Red Mesa	2	0.6	-	-	-	-	-	-	-	-	-	-	2	0.5
Red Mesa	13	0.5	-	-	7	1.7	-	-	-	-	-	-	20	0.5
Puerco B/w	3	0.9	-	-	2	2.7	-	-	-	-	-	-	5	0.9
Gallup B/w	4	0.4	-	-	4	1.2	2	4.1	1	0.5	-	-	11	0.7

Table 2.17. (continued)

Type	Vessel Form												Total	
	Bowl		Ladle		Jar		Olla		Other closed		Other			
	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type-form	No.	% Type
Chaco B/w	-	-	-	-	2	7.7	-	-	-	-	-	-	2	2.7
Exotic M/w	-	-	-	-	1	1.1	-	-	-	-	-	-	1	0.3
PII-III M/w	2	0.2	-	-	5	1.0	-	-	1	0.6	-	-	8	0.3
Unidentified White	43	8.3	1	1.2	6	2.1	-	-	-	-	2	1.9	52	4.6
BMIII-PI Unpolished C/w	48	52.2	-	-	-	-	-	-	-	-	1	100.0	49	49.5
BMIII-PI Polished C/w	63	42.3	-	-	1	3.4	-	-	-	-	-	-	64	33.9
PII-III C/w	-	-	-	-	-	-	-	-	-	-	1	16.7	1	0.4
Tusayan White	1	1.2	-	-	-	-	-	-	-	-	-	-	1	1.1
Chuska B/w	1	1.3	-	-	-	-	-	-	-	-	-	-	1	0.9
Chuska Red Mesa	-	-	-	-	1	4.3	-	-	-	-	-	-	1	0.8
Polished Smudged	1	0.3	-	-	-	-	-	-	-	-	-	-	1	0.3
TOTAL	418	4.6	2	0.2	328	4.3	24	4.8	22	1.7	11	2.3	805	4.0

Note: No fugitive red in Escavada, Chaco McElmo, Mesa Verde Black-on-whites or Chuska Carbon-on-white.

Table 2.18. *Chaco handles through time.*

	Pre A.D. 820		A.D. 820-920		A.D. 920-1040		A.D. 1040-1100		A.D. Post 1100		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bowl												
Solid Coil	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Multiple Solid Coil	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Nubbin	-	-	-	-	1	0.1	-	-	1	2.0	2	0.2
Dual Nubbins	1	1.4	-	-	-	-	-	-	-	-	1	0.1
Indented	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Strap Lub	1	1.4	-	-	10	1.1	6	3.7	5	9.8	22	1.7
Solid Tabular Lugs	-	-	-	-	5	0.5	-	-	-	-	5	0.4
Perforated Lug	1	1.4	-	-	1	0.1	-	-	-	-	2	0.2
Multiple Coil Strap	-	-	-	-	3	0.3	1	0.6	-	-	4	0.3
Gray Jar												
Solid Coil	7	9.9	1	2.0	10	1.1	2	1.2	-	-	20	1.6
Multiple Solid Coil	-	-	4	8.0	19	2.0	2	1.2	-	-	25	2.0
Strap	6	8.5	1	2.0	13	1.4	3	1.9	-	-	23	1.8
Tubular	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Extended Lip	-	-	-	-	10	1.1	-	-	-	-	10	0.8
Nubbin	2	2.8	5	10.0	88	9.5	13	8.0	3	5.9	111	8.8
Dual Nubbins	-	-	-	-	15	1.6	1	0.6	1	2.0	17	1.3
Strap Lug	2	2.8	2	4.0	8	0.9	-	-	-	-	12	1.0
Solid Tabular Lugs	-	-	-	-	16	1.7	1	0.6	-	-	17	1.3
Cupule Lug	-	-	-	-	9	1.0	-	-	-	-	9	0.7
Down-curved Nubbins	1	1.4	-	-	4	0.4	2	1.2	3	5.9	10	0.8
Perforated Lug	3	4.2	-	-	4	0.4	-	-	-	-	7	0.6
Bifurcated Lip	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Multiple Coil Strap	-	-	-	-	4	0.4	-	-	-	-	4	0.3
Effigy Handles	-	-	-	-	-	-	1	0.6	-	-	1	0.1
Ladle												
Solid Coil	2	2.8	3	6.0	7	0.8	1	0.6	1	2.0	14	1.1
Multiple Solid Coil	-	-	-	-	1	0.1	-	-	1	2.0	2	0.2
Strap	2	2.8	4	8.0	22	2.4	2	1.2	1	2.0	31	2.5
Tubular	-	-	-	-	37	4.0	17	10.5	6	11.8	60	4.8
Perforated Tubular	-	-	-	-	4	0.4	2	1.2	1	2.0	7	0.6
Trough-Gourd	5	7.0	10	20.0	247	26.6	65	40.1	3	5.9	330	26.2
Strap Lug	-	-	-	-	1	0.1	-	-	1	2.0	2	0.2
Pitcher												
Solid Coil	2	2.8	1	2.0	3	0.3	-	-	1	2.0	7	0.6

Table 2.18. *(continued)*

	Pre A.D. 820		A.D. 820-920		A.D. 920-1040		A.D. 1040-1100		A.D. Post 1100		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Multiple Solid Coil	3	4.2	1	2.0	16	1.7	2	1.2	1	2.0	23	1.8
Strap	5	7.0	3	6.0	67	7.2	25	15.4	8	15.7	108	8.6
Tubular	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Nubbin	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Effigy Handles	-	-	-	-	-	-	-	-	2	3.9	2	0.2
<u>Tecomate</u>												
Nubbin	1	1.4	-	-	-	-	-	-	-	-	1	0.1
Perforated Lug	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Effigy Handles	1	1.4	-	-	-	-	-	-	-	-	1	0.1
<u>Olla</u>												
Multiple Solid Coil	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Strap	-	-	-	-	-	-	1	0.6	-	-	1	0.1
Indented	-	-	1	2.0	11	1.2	2	1.2	1	2.0	15	1.2
Strap Lug	-	-	-	-	2	0.2	-	-	1	2.0	3	0.2
Solid Tabular Lugs	-	-	-	-	1	0.1	-	-	1	2.0	2	0.2
Perforated Lug	-	-	-	-	1	0.1	-	-	-	-	1	0.1
<u>Whiteware Jar</u>												
Solid Coil	-	-	-	-	10	1.1	-	-	-	-	10	0.8
Multiple Solid Coil	-	-	-	-	10	1.1	-	-	-	-	10	0.8
Strap	1	1.4	2	4.0	41	4.4	1	0.6	1	2.0	46	3.6
Nubbin	-	-	1	2.0	5	0.5	-	-	-	-	6	0.5
Indented	-	-	-	-	2	0.2	-	-	-	-	2	0.2
Strap Lug	1	1.4	1	2.0	21	2.3	6	3.7	2	3.9	31	2.5
Solid Tabular Lugs	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Cupule Lug	-	-	-	-	2	0.2	-	-	-	-	2	0.2
Down-curved Nubbins	-	-	-	-	-	-	1	0.6	-	-	1	0.1
Perforated Lug	3	4.2	1	2.0	15	1.6	1	0.6	-	-	20	1.6
Multiple Coil Strap	-	-	-	-	6	0.6	1	0.6	-	-	7	0.6
Bifurcated Tab Lugs	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Effigy Handles	-	-	-	-	3	0.3	1	0.6	1	2.0	5	0.4
<u>Canteen, Duck Pot, Seed Jar, Gourd Jar</u>												
Solid Coil	1	1.4	-	-	2	0.2	-	-	1	2.0	4	0.3
Strap	-	-	-	-	2	0.2	-	-	-	-	2	0.2
Tubular	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Strap Lug	-	-	-	-	4	0.4	-	-	-	-	4	0.3
Perforated Lug	-	-	-	-	3	0.3	-	-	1	2.0	4	0.3

Table 2.18. (continued)

	Pre A.D. 820		A.D. 820-920		A.D. 920-1040		A.D. 1040-1100		A.D. Post 1100		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Effigy Handles	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Effigy, Miniature												
Solid Coil	-	-	-	-	2	0.2	-	-	1	2.0	3	0.2
Strap	-	-	-	-	3	0.3	1	0.6	2	3.9	6	0.5
Tubular	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Trough-Gourd	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Nubbin	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Solid Tabular Lugs	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Effigy Handles	-	-	-	-	3	0.3	-	-	-	-	3	0.2
Unknown Form												
Solid Coil	7	9.9	3	6.0	43	4.6	-	-	-	-	53	4.2
Multiple Solid Coil	2	2.8	4	8.0	27	2.9	-	-	-	-	33	2.6
Strap	10	14.1	2	4.0	49	5.3	-	-	-	-	61	4.8
Tubular	-	-	-	-	10	1.1	-	-	-	-	10	0.8
Perforated Tubular	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Nubbin	1	1.4	-	-	-	-	-	-	-	-	1	0.1
Strap Lug	-	-	-	-	3	0.3	1	0.6	-	-	4	0.3
Cupule Lug	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Down-curved Nubbins	-	-	-	-	1	0.1	-	-	-	-	1	0.1
Perforated Lug	-	-	-	-	1	0.1	-	-	-	-	1	0.1
TOTAL	71	99.80	50	100.0	927	99.3	162	99.5	51	100.7	1,261	101.0

The shape of the body of the vessel ranges from nearly spherical to relatively tall with rounded shoulders (see Judd 1954:Plate 64; Peckham 1990:74, 75, 82, 84; Toll and McKenna 1992:216). Frequently, the neck decoration seems unrelated to the main design panels on the body of the vessel (see Peckham 1990:74, 75). Ollas often have some form of handles—either straps or, most commonly, indentations in the vessel body—below the maximum diameter (Table 2.18; see Toll and McKenna 1992:216). Distinguishing this form from "jar" depends on a large enough sherd; clues that a sherd is from an olla as defined here include the greater wall thickness, the broad curvature of the walls, the shape of the vessel base, and the size and layout of the design. It is likely that sherds identified as coming from ollas in the sample somewhat underrepresent the actual occurrence of the vessel form in the vessel assemblage. Some temporal change in the general shape of this vessel form is evident; in earlier examples, beginning with Lino Gray and extending into early Pueblo II, the line from the shoulders to the rim tends to be a gradual sweeping one, while later examples tend to have a more defined angle between the base of the neck and the body of the vessel (Figure 2.4). With their restricted orifices (mean diameter of 77 mm, with 95 percent less than 105 mm diameter), these vessels

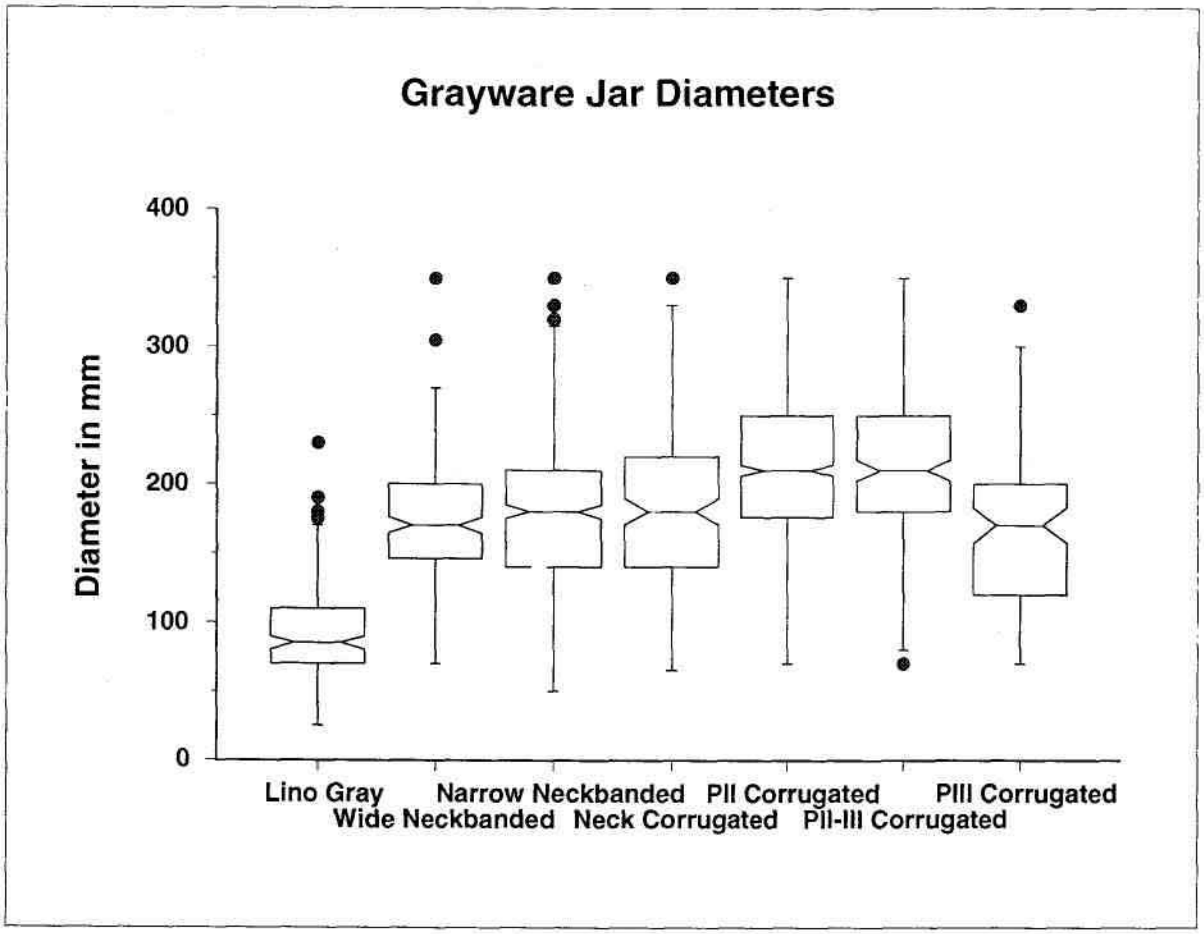


Figure 2.6. *Box plot of grayware jar diameters by type. Sample is composed as follows:*

Lino Gray	*171*
Wide Neckbanded	*207*
Narrow Neckbanded	*505*
Neck Corrugated	*175*
PII Corrugated	*875*
PI-III Corrugated	*211*
PIII Corrugated	*96*
Total	*2,240*

Lino Fugitive is included with Lino Gray. In the notched box plots the box top and bottom lines represent the interquartile range (25 to 75 percent), the line within the box is at the median; if the notches of the two boxes do not overlap, there is a 95 percent chance that the samples are different on the measurement in question (Chambers et al. 1983:60-63). Range of values is shown by lines outside boxes, extremes and [statistical] outliers are plotted individually.

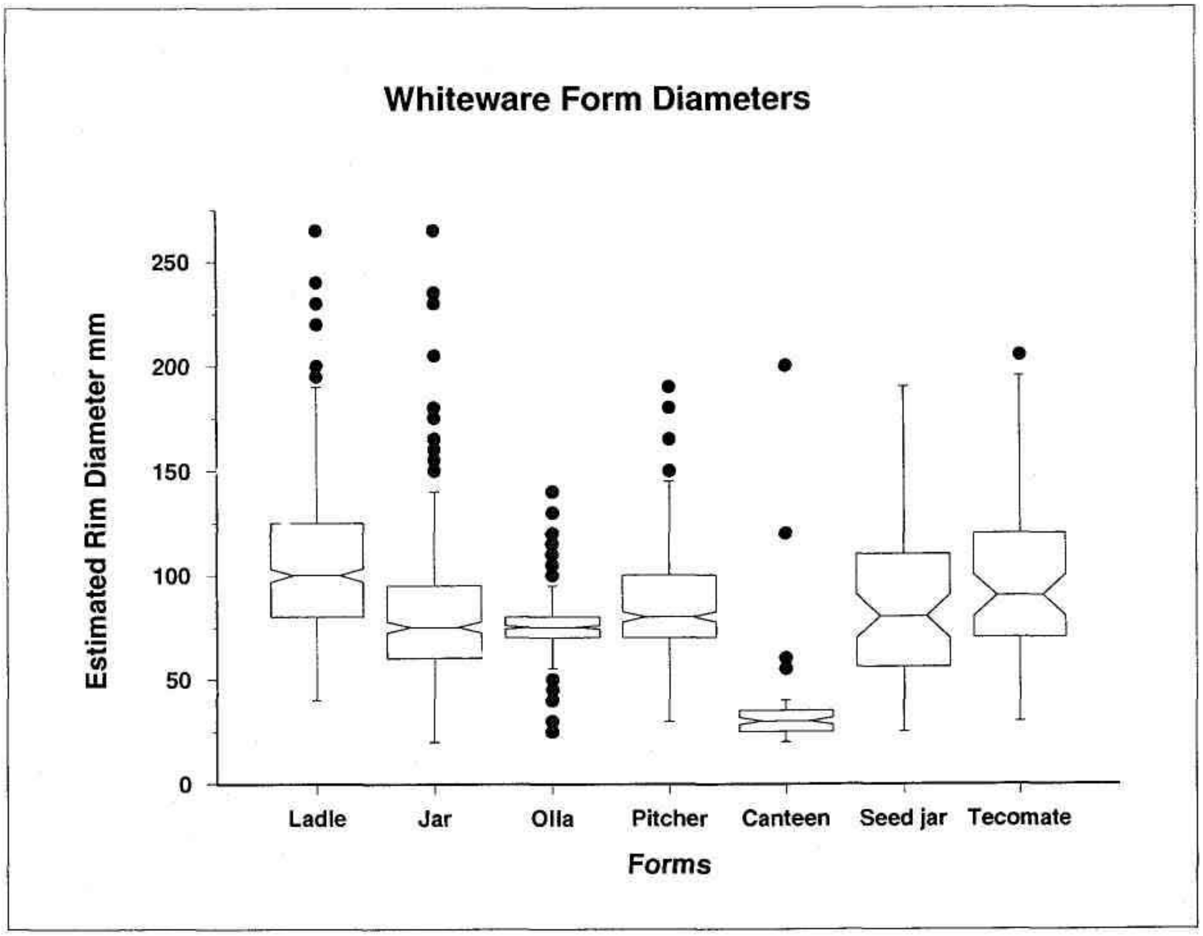


Figure 2.7. *Box plot of rim diameters of non-bowl whiteware forms. In notched box plots the box top and bottom lines represent the interquartile range (25 to 75 percent), the line within the box is at the median; if the notches of the two boxes do not overlap, there is a 95 percent chance that the samples are different on the measurement in question (Chambers et al. 1983:60-63). Range of values is shown by lines outside boxes, extremes and [statistical] outliers are plotted individually.*

seem suitable for water storage, and the form is reminiscent of Mesoamerican water jars (see Reina and Hill 1978). Full of water, the larger of these vessels would be unmovable, and they were also surely used for storage of dry materials as well (a vessel of this category was found in a Mesa Verde cliff dwelling full of shelled corn).

Pitcher

Pitchers are defined by their size, shape, and by the presence of a single handle which is usually a vertical strap attached near the vessel rim and the base of the neck. They are usually taller than they are wide, and often have a definable neck and a globular base. A form commonly associated with Chaco are straight-necked (perhaps tapering slightly to the rim), sharp-shouldered whiteware pitchers (Figure 2A.13; see Cordell 1984c:263 who confuses this form with cylinder jars). It would have been useful to have recorded the more specialized, square-shouldered, pitcher form as a separate category to assess its relative occurrence in Chaco Canyon and elsewhere. On the whole, this "classic" Chaco pitcher form seems to be late and rather uncommon. Judd's plates, for example, show three of 15 Gallup, Chaco, and Puerco Black-on-white pitchers, and three Chaco McElmo Black-on-white pitchers of this type (Judd 1954:Plates 57, 63a-c; see also Windes 1985: 38).

Pitchers are present through time, but are most abundant in the A.D. 900 to 1100s. Pitchers tend to become taller and less globular later (see Peckham 1990:46, 48, 66, 75, 80, 104 for this trend); orifices average around 8 cm (Figure 2.7). Pitchers occur most commonly as whitewares, although there are also grayware examples throughout the sequence, and the pitcher form is common among miniature vessels. Unlike most of the other special (non-bowl) whiteware forms which are quite rare, pitchers are numerous. Chaco Black-on-white has the highest percentage of pitchers of all types and Chaco McElmo the second highest (Table 2.18). Although present in the earliest types, pitchers increase in frequency and are most common in these two late, well-made types.

Mills (1993a:306) notes that in the ENRON project, assemblage pitchers are often found with burials, but that only one of 16 burials had more than one pitcher, suggesting that they were a personal item. Burials at Chaco do not follow this pattern so tidily, with each of six burials having two or more pitchers at Gallup Phase small sites and at Pueblo Bonito (Akins 1986:92, 96, 108). Pitchers occur with burials more often than would be expected from their general occurrence (Akins 1986:126-128).

More than any other form, pitchers in the Chaco Project assemblage have a white to yellowish mineral deposit on the interior, indicating that some liquid stood in these vessels long enough to evaporate. Of 95 recorded instances of mineral encrustation, 45 (or 9 percent of all pitchers) were on whiteware pitchers and 40 were on whiteware jars (some of which may be pitcher sherds). Only two olla sherds have this deposit, suggesting that it may not result from water storage. This variable was also used for recording sooting, making its observation for graywares unreliable, but only two instances were recorded on gray sherds (over 2,000 gray jar sherds were recorded only as sooting absent, and were presumably candidates for having this code used were the encrustation present). The absence of this deposit in whiteware ollas and the color of many of the deposits leads us to speculate that some pitchers may have served as chamber pots.

Mug

The flat-bottomed form with a handle extending from near the rim to near the base is a late form, almost always in a late, carbon-painted type, primarily Mesa Verde Black-on-white (or Crumbled House) or McElmo (see Cattanach 1980:202-203; Rohn 1971:175-177). It is extremely rare in the Chaco Project collections—a total of four vessels were called mugs, and three are questionably "classic" mugs. Two of these (from 29SJ 627 and 29SJ 629) lack the handle and are more properly "cups" (see Windes 1993:317); the other is from Pueblo Alto and is a small sherd with a suspicious diameter estimate. The best example is from the Mesa Verde Black-on-white era room at 29SJ 633 and is trachyte-tempered (see McKenna and Toll 1991:147, 176). Mugs with cylindrical or conical shapes can easily be seen as a modification of the square-shouldered pitcher form discussed above (see Judd 1954:203; Bradley 1996:247-248).

Seed Jar

As used here, this form was used almost strictly for whitewares and redwares (one Lino Gray seed jar was recorded; see tecomate below). The seed jar form is distinguished by a neckless, usually round orifice, considerably smaller than the maximum diameter of the pot. Seed jars can be nearly spherical, but often the top of the vessel is flattened, resulting in shoulders where the curved base joins the top (see Judd 1954:Plate 66; Peckham 1990:71-73; Toll and McKenna 1992:215, 2.30-1). This form occurs over a long time span, but is never common.

Tecomate

In this analysis, tecomate refers to globular vessels with round, restricted orifices and no neck (Figure 2A.1). This definition is different from many other studies, which are more likely to refer to this form as seed jars (see Mills 1993a:306-307; Morris 1980:Figure 27 e-j, Figure 29 f,j), a term used in this analysis for smaller, painted vessels with flattened tops and neckless rims similar to "tecomate" rims (see above). As employed in this analysis the term covers two groups. Most (83 percent of the 513 cases) are found in early contexts, and usually as either Lino Gray or Polished Tan Gray, but also as some early plain redware vessels. The remaining tecomates are later whitewares and a few redwares. These vessels are taller and larger than those called seed jars, although the mean orifice diameters of the two forms overlap considerably (seed jar mean 87 mm, tecomate mean 96 mm; see Figure 2.7), with tecomate diameters being more variable. Morris (1939:144) calls the early, plain form "squash pots," and Roberts (1929:111-112) calls them spherical or globular vessels with wide orifices. In Mesoamerica, tecomate refers to figure-eight, gourd-shaped vessels used as canteens (Reina and Hill 1978:25).

Canteen

Usually somewhat flattened spheres, canteens are vessels with very small, necked orifices (mean diameter of 34 mm) and handles at the shoulders (Figures 2.7 and 2A.18; Judd 1954:Plate 65). As with ollas, the decoration of the neck is usually independent of the main designs on the body. The small orifice could have been easily stoppered and the suspension lugs would allow carrying and hanging by a cord, making this a form useful (if perhaps fragile) for carrying drinking water.

Duck Pot

Duck pots, sometimes called shoe-form vessels (Rice 1987:236), bird-form vessels (Morris 1939), patojos or zapatojos (Varner 1974), or even pichingas (Reina and Hill 1978:163-165), are oblong-shaped with an upward-pointing orifice at one end and a pointed or rounded ("duck butt") opposite end. Variations on this form occur throughout the pottery sequence (Morris 1939:245). Based on its ethnographic use, it has been suggested that this form was designed to be placed with the closed end in the fire in order to keep the contents hot, or to be used as comal rests. All 24 of the identified duck pots in this assemblage are whitewares, and only one has blackening, suggesting that these vessels were seldom used for heating. Nearly half of this sample has some form of handle, and a number have effigy heads (Judd 1954:Plate 63). It seems likely that at least two functional types are included in this vessel form: larger, closed forms with handles probably used as containers (see Peckham 1990:49), and smaller, more open vessels probably serving as effigies (e.g., at Pueblo Alto—Windes 1987(2):120; Peckham 1990:76). Eddy (1966:435-437) emphasizes the effigy aspect in interpreting this form as part of a water control cult. In the Tehuacan Valley in Mexico, this form frequently contained cremated human remains (Sisson 1975), indicating a wide variability in function over space for this class of vessel.

Gourd Jar

This form is found in earlier contexts (see Morris 1939:245); there are no examples of this form in types postdating Red Mesa Black-on-white. We identified only whiteware examples of this form, all but one of them decorated (Table 2.14). The shape mimics that of some squashes and gourds (Cucurbita sp.—the shape could be one of several cucurbit species [M. Toll personal communication 1995]); the small opening (mean diameter 3.8 cm, 13 cases) of the vessel is near where the stem would be. Sometimes the neck of the gourd curves back to the vessel, forming a handle. There is some convergence of form between gourd jars and pitchers, and even with "bird effigies" (Peckham 1990:64). Good examples of this form may be seen in Morris (1939:Plate 226) or Peckham (1990:102).

Cylinder Jar

Just as a late, rare decorative style (Chaco Black-on-white) has entered the archeological subconscious as representative of Chaco Canyon, an even rarer late form—the cylinder jar—has a similar association. There is some basis for association since 200 of 210 known cases come from the core canyon; 192 of those come from Pueblo Bonito (Toll 1990:282-283). This popular image is further shaped by the selectivity of those who choose to illustrate this form; of the 210, just a few of the best executed Chaco Black-on-white, tall and very regular vessels show up in photos (e.g., Neitzel and Bishop 1991; Sebastian 1992:47; Washburn 1980; Lister and Lister 1981:46, which shows both cylinder jars and shouldered pitchers on the same page). The form is far more variable in shape than this selection conveys, solid designs and carbon paint are present on some vessels, and up to a third are plain whiteware (Judd 1954:Plates 67-68; Toll 1990). Further, it is likely that they came from a number of sources. Some are very likely to have come from the Chuska area, but others do not contain trachyte temper (Neitzel and Bishop [1991:70, 72] imply that we were able to examine "many" cylinder jars, which sadly is not so). Of the quarter million potsherds collected by the Chaco Project, two were identified as coming from cylinder jars, one from 29SJ 633 and one from 29SJ 1360.

The majority of painted cylinder jars are hachured, divided between Gallup and Chaco Black-on-white. There are also some with solid design elements; these are mostly Chaco McElmo Black-on-white, but also include some Puerco Black-on-white. Given the frequency with which hachured cylinder jars are illustrated, a surprising quarter to over a third of recovered cylinder jars (at least 47 of 210) are unpainted whiteware (Washburn 1980; Toll 1990:289). The typological makeup of this vessel form indicates that it was made between A.D. 1050 and the early A.D. 1100s. There is a single Red Mesa Black-on-white (pre-A.D. 1040) unprovenienced example (see Peckham 1990:71; Judd 1954:210); its shape is different but within the range of shapes within the vessels from Pueblo Bonito. While the association of hachure with Chaco is unclear because of the widespread occurrence of hachure in the Anasazi area, the association of cylinder jars with Chaco Canyon is far more distinct.

Other Forms

Effigies

As with cylinder jars, Pueblo Bonito has a concentration of human effigy forms which are found at few other sites, although human effigies are even rarer than cylinder jars (Ellwood and Parker 1993). The Chaco Project assemblage contains no recognizable pieces of human effigy vessels; Franklin reports a head from the Salmon Ruin (1980:561) and another head from an arroyo near a small site in the Bis sa'ani Community (1982:904-906). Pueblo Bonito also produced a relatively large number of animal and other effigies (see Judd 1954:217-223, Plate 88). The Chaco Project collection does contain 43 effigy forms, all from 29SJ 627 (63 percent), 29SJ 629, 29SJ 633, and 29SJ 1360. Most are whiteware (38) with a few red (2), gray (2), and brown (1) wares as well. Whitewares are of types of all periods. Effigy forms include frogs, artiodactyl feet, a solid (rather than vessel) possible human figure (McKenna and Toll 1991:174-175), badger forms, frogs, deer, or other quadruped. "Submarine" vessels seem to be nearly absent from Chaco Canyon sites, although a small rim sherd from such a vessel would be called a canteen.

Miniatures

Small vessels occur in small numbers in most types. They are usually closed forms (jars, pitchers), although we did not record the form past "miniature" (for examples see Judd 1954:Plate 69, page 216; Toll and McKenna 1992:218).

Pipes

Pipes occur throughout the sequence. Most are whiteware, although many have little or no design on them. They are usually short, truncated cones with a hollow place for the dottle in the broader end (mean diameter 1.7 cm, range 1.5 to 2.5 cm, 6 cases) and a passage through to the mouth end.

Form Assemblages through Time

A dramatic and widespread change in vessel form took place from early grayware (Lino Gray) jars with necks and tecomates (both with small orifices) to the wide-mouthed jars that followed (Table 2.15). This change has two components —change in the role of ceramics in food preparation involving more boiling, probably as part of a greater reliance on agricultural products (Blinman 1988), and the development of more task-specific whiteware forms (Wilson and Blinman 1995:70-77). Although the number of grayware forms is greater in the earlier periods than in later periods (partly because decoration covers smaller percentages of vessel surfaces in early "whitewares"), graywares are nearly always closed forms in all time periods. The greater variety in grayware forms in early contexts also stems from the dominance of grayware at that time—whitewares are a far smaller percentage of those time periods than they are in succeeding ones.

After more specific whiteware forms developed during Pueblo I, however, the whiteware form assemblage stays remarkably similar through time (Table 2.15). There is an early decline in the relative frequency of bowls and a small increase in pitchers. There is minor oscillation in the rarer forms, but the percentages are remarkably stable from one well-represented time group to the next. There are a few forms which are more temporally localized but these are quite rare: gourd jars in the A.D. 900s, cylinder jars in the late A.D. 1000s to early A.D. 1100s, and mugs after A.D. 1200. As noted in the form discussion, some temporal change took place within form classes, notably ladles, pitchers, and ollas (Figure 2.4). Subtle changes in forms did occur through time, but classes of vessel forms remained quite constant.

Based on sherd counts, Windes (1985:29, 39) finds that later Chaco Cibola Whitewares reach "near parity of open and closed" forms. Although an increase in closed forms is apparent in the rim sample discussed here, open forms are always in the neighborhood of 70 percent of the whiteware assemblage (Tables 2.14 and 2.15). This is in part a result of the sampling strategy, but suggests that, in terms of numbers of vessels, decorated closed forms probably never outnumbered open forms.

Grayware jar diameters increase steadily through typological time to Pueblo II-III Corrugated, but show a marked decrease in Pueblo III Corrugated (Figure 2.7). Whiteware bowls show a similar trend of increase through Pueblo II-III with a decrease in early Pueblo III (Figure 2.5). Mills (1993a:344-346) documents similar increases in these vessel sizes in several geographic areas, but in the ENRON San Juan Basin sample the largest median gray jar diameter is in Pueblo I, and Pueblo III is lacking. Vessel size is sometimes interpreted as indicative of the size of group being served (Blinman 1988:200-205; Mills 1993b:416). Interpretations of the terminal period of pueblo occupation (post A.D. 1200) in Chaco Canyon range from nearly absent to present, but greatly scaled down (Toll et al. 1980), to fully functional, continuing polity (Wilcox 1996). While this late period remains under-sampled and under-appreciated (McKenna 1991), these reduced vessel sizes correspond with reduced building effort to further the impression that social investment and interaction were reduced after the early A.D. 1100s.

Handles. Handles were generally included in the detailed analysis. Over a third of the handles in the sample came from ladles (Tables 2.18 and 2.19). Aside from the trough and tubular shapes of ladle handles, handles fall into three main classes: straps or coils of clay welded to the vessel leaving a handle hole; protrusions pulled out from the surface of the vessel; or indentations into the vessel. Indentations are found only in large whiteware jars. Protrusions from the vessel are especially common in grayware jars, usually occurring at or near the vessel orifice. Solid tabular pieces of clay without space between the handle and the vessel are also more common on gray jars. If handles standing away from the vessel wall are found on graywares, they are likely to be coils, either one or several twined together. Strap handles, such as the vertical type found on pitchers or the horizontal straps on jars and ollas, are the most common handle type on whiteware vessels. When whiteware vessels have the protrusion type handle, they are often perforated. The differences between grayware and whiteware handles probably relate to adding grip to cooking pots as opposed to means of suspension and carrying on whiteware vessels because handles sufficiently large and strong for carrying a large vessel are rare (absent?) on grayware jars.

The handle repertoire remained rather constant through time and across forms (Table 2.18). As mentioned, open gourd form ladle handles are prevalent into the A.D. 1000s, being gradually replaced by ladles with bowls separated from tubular, or occasionally tabular handles. The relatively rare cupule form was recovered only from A.D. 920 to 1040 contexts. Straps, coil, and nubbin handles are present throughout the sequence. Indentations in vessel sides appear around A.D. 900 and continue through the A.D. 1100s. Although this handle form is associated with large closed forms (mostly ollas), this handle type was not observed in the graywares.

Whole Vessel Measurements

Although vessels are the unit in which we are interested, it is one with which we seldom deal. Measurements were collected on 282 reasonably

Table 2.19. All handle types by ware.

	Grayware		Whiteware		Redware		Brownware		Total	
Handle Type	No.	% of Type	No.	% of Type	No.	% of Type	No.	% of Type	No.	% of Total
Solid Coil	75	43.4	95	54.9	3	1.7	-	-	173	8.7
Multiple Solid Coil	65	46.1	74	52.5	2	1.4	-	-	141	7.1
Vertical Strap	87	20.3	336	78.5	4	0.9	1	0.2	428	21.6
Tubular	3	2.4	121	96.8	1	0.8	-	-	125	6.3
Tubular with Perforations	-	-	20	100.0	-	-	-	-	20	1.0
Trough-Gourd	-	-	499	99.8	-	-	1	0.2	500	25.2
Extended Lip	12	100.0	-	-	-	-	-	-	12	0.6
Nubbin	177	92.7	13	6.8	1	0.5	-	-	191	9.6
Dual Nubbins	28	93.3	1	3.3	-	-	1	3.3	30	1.5
Indented	-	-	26	100.0	-	-	-	-	26	1.3
Strap Lug	18	13.3	117	86.7	-	-	-	-	135	6.8
Solid Tabular Lugs	28	59.6	18	38.3	1	2.1	-	-	47	2.4
Cupule Lug	9	50.0	9	50.0	-	-	-	-	18	0.9
Curved or Sagging Nubbins	19	90.5	2	9.5	-	-	-	-	21	1.1
Perforated Lug	14	23.0	46	75.4	1	1.6	-	-	61	3.1
Bifurcated Extended Lip	1	100.0	-	-	-	-	-	-	1	0.1
Multiple Coil Strap Lug	5	17.9	23	82.1	-	-	-	-	28	1.4
Bifurcated Tabular Lugs	1	50.0	-	-	1	50.0	-	-	2	0.1
Effigy Handles	2	9.5	18	85.7	1	4.8	-	-	21	1.1
Vertical fillet	2	100.0	-	-	-	-	-	-	2	0.1
TOTAL	546	27.5	1,418	71.5	15	0.8	3	0.2	1,982	100.0

whole vessels, but that number includes a fair number from excavation that are sufficiently complete to calculate a volume but which are not whole by any collector's standards. These vessels came from a variety of places: the Chaco Project excavations, earlier excavations in Chaco Canyon (scattered pots from the "Bc" sites, but no complete collections), and from the Maxwell Museum collections. The vessels in the Maxwell Museum are mainly donations with little or no provenience information. A sizable portion of the vessels measured there were collected by Earl Morris for the Carnegie Institution and given to the Maxwell Museum in 1942. It is very likely that the majority came from the Chuska Valley where Morris is known to have done some digging (Lister and Lister 1968).

Volumes of all these vessels were measured by filling them with vermiculite. Vermiculite is not an ideal substance for measuring volume because it is so light that it is subject to variable settling (not to mention the micaceous dust it leaves on everything). It is, however, light enough that most fragile, reconstructed pots can withstand being filled with it. Most of the measurements were taken with the idea that we wished to compare the measurement possible from sherds (rim diameter) with its counterpart from vessels and compare it to volume. Accuracy to the nearest 10 cc is not really possible, but that is the level for which we aimed (values to the nearest cc are from calculated volumes). Clearly, it would be desirable to have a fuller set of descriptive measures for whole vessels, but that realization came late. Summary measurements for five abundant forms are presented in Table 2.20; data for individual types are presented in the detailed type definitions.

As can be seen in Table 2.20, the correlations between diameter and volume for grayware jars and whiteware bowls are pretty good (significant Pearson's r greater than 0.8) and less strong for pitchers and ladles. The low correlation for ladles is easily understood given the presence of both solid handle and half gourd shapes. The lower pitcher correlation in both wares may result from a functional dictation of pitcher orifice size, repeated in the lower correlation of pitcher heights and diameters. The correlations between height and volume are quite high, but the number of height measurements is small. The volumes in all categories are extremely variable, virtually demonstrating that each category covers a number of functional types.

Relative to the sherd sample, there is a very high percentage of grayware pitchers compared to grayware jars. This probably results from several things. Grayware pitchers are smaller than jars and are probably, therefore, more likely to survive intact. Again compared to the larger grayware jars, pitchers are more common as grave goods, increasing the likelihood of being found intact. Additionally, pitchers may possibly have been used less for cooking, and may therefore have experienced less heat stress. Finally, because the handle type is a primary criterion in the designation pitcher, a fair number of pieces of grayware pitchers have probably been recorded as jar sherds because of the absence of a handle.

Detailed Analysis: Temper and Paste Studies

Objectives

In keeping with a long tradition of pottery description in the Southwest, the Chaco Project included temper and paste studies in its analytical ambitions. While temper and paste have received varying emphasis in the several schemes of Chaco ceramic classification, work before the Chaco Project clearly indicated that there was considerable potential for identification of ceramic sources within the San Juan Basin. The great relevance of a regional perspective to the understanding of the Chaco Phenomenon made temper an appropriate focus for analysis. The objectives of identifying ceramic temper from Chaco Project excavations included the following:

1) Furnishing quantified temper and paste occurrences for type descriptions. Although temper is frequently included in type descriptions, it has often been in terms such as "abundant" or "common." Temper is a criterion for some types but not others, including the Chaco Project classification system. This is not an ideal situation because types would be, in my opinion, most useful as fully phenotypic groups against which temper should be allowed to vary. In this way, production and consumption (and perhaps group representation) could be more thoroughly examined. While this independence is not complete here, it can be largely recreated.

Table 2.20. Whole vessel measurements and correlations for five abundant ware-form categories.

Means, Ranges, CV	Volume (cc)	Rim Diameter (mm)	Height (mm)
Grayware jar	9,043.2	179.5	267.4
range	50-21,220	56-260	131-385
CV%	76.9	33.4	43.0
n	37	33	5
Grayware pitcher	1,296.9	96.9	148
range	150-4,440	56-170	105-195
CV%	94.9	33.0	25.6
n	14	12	4
Whiteware bowl	1,495.1	175.7	79.3
range	63-8,870	75-360	51-110
CV%	84.8	28.3	24.0
n	144	144	22
Whiteware pitcher	1,207.8	17.3	36.9
range	100-2,450	35-95	84-191
CV%	61.9	23.6	27.7
n	20	20	6
Whiteware ladle	256.6	97.2	38.0
range	30-1,404	65-180	31-50
CV%	117.3	27.2	27.5
n	26	25	3

2) Serving as a basis for examining ceramic movement, inter- and/or intra-regionally. Given identifiable sources, temper is one of the most definite keys to location of production, down to a fairly fine level of discrimination.

3) Providing functional and technological information. Temper and paste may provide information on intended vessel use and methods of production.

Background and Epistemology

The question of how to accomplish temper identifications had both theoretical and practical aspects. On the one hand, results with the most control and greatest detail are the most desirable. On the other hand, such results generally require the most time per specimen in analysis and there is a likelihood that more information than will be useful will be generated. Ideally, thin-section analysis would be performed on a large number of items, perhaps the whole detailed analysis sample, but this level of detail is completely impractical. Shepard (1956:157-161) provides a good discussion of the ideal interplay between the use of petrographic and binocular microscopes in the analysis of temper. This interplay was largely lacking from the Chaco Project analysis for several reasons:

1) A very substantial body of work on ceramics existed in the area before the Chaco Project began. Important among these are the work of Shepard (1939, 1954 [in Judd 1954], 1963), Hawley (1936), Vivian (1959, 1965); Vivian and Mathews (1965), Warren (1967), and Windes (1977; see also Loose 1977). This work had established a group of tempers found in Chaco Canyon that could be identified with a binocular microscope. Roberts' (1927) work on the Chaco ceramic sequence was a critical, if often an invisible cornerstone to much work on Chaco ceramics. He placed very little emphasis on paste, being concerned almost entirely with modes of decoration. Between the perceptive work of Roberts and the pioneering work of Shepard in this very early phase of Chaco ceramic analysis, there was a close brush with what might have been an extraordinary collaboration, and an opportunity for establishing an analysis of independently varying paste and design

that would be remarkable today. This collaboration, unfortunately, remained limited and tangential, and truly independent paste and design studies have yet to materialize.

2) The personnel, equipment, and time available did not permit the use of petrographic analyses. A. H. Warren was contracted by the Chaco Project in 1975 to conduct ceramic source analyses (Warren 1976, 1977). Warren had geological training and had done petrographic work with ceramics (e.g., Warren 1967, 1976). She made some powdered sample analyses of Chaco ceramics and various sandstones early in her analyses, but then concentrated on binocular microscope identifications.

3) The primary objective of the analysis was to have full information on as large a sample as possible.

Who does an analysis, what they know, and when the analysis is done all have an effect on the outcome. Thomas Windes, A. H. Warren, Peter McKenna, and I were all involved in numerous ways with the various aspects of temper analysis. Windes participated in the early planning of the analysis and, in his separate analyses of surface ceramics and pottery recovered after the Chaco Project, included some temper identifications. His primary role in the analysis reported here, however, was that of consultant. Warren was the technical consultant and her work forms the basis for much of the procedure that was eventually used. While she examined many Chaco Project sherds, her identifications are only a small part of those reported in this analysis. McKenna used the project recording system in the analysis of the sherds from part of 29SJ 626, 29SJ 630, 29SJ 1360 and a test at Shabik'eshchee (29SJ 1659); only the two latter sites are included in this final analysis. I was responsible for the identification and recording of the pastes of the remainder of the ceramics. My efforts were based almost entirely on what the other three were able to teach me.

Any analyst using a binocular microscope to identify temper develops certain mind sets as to cues to a temper's identity. Such cues revolve around similar attributes from analyst to analyst, but they are not likely to be entirely similar. Further, two analysts are unlikely to see exactly the same particles in each sherd in a group of hundreds of sherds. Therefore, some inconsistency is unavoidable under this system. What it relies on is that there will be an overall agreement showing similar proportions of various tempers. While there is, in every case, a right answer to the question of where a vessel was made, it is unreasonable to expect that any analyst will always find that answer, especially given the widespread and non-distinctive tempers such as are found in a substantial portion of the Chaco assemblage. Without an extensive thin-section back-check program, the "right answer" is, practically speaking, a matter of consensus. Blind consistency tests were conducted on two different occasions; once with problem sherds from 29SJ 1360, and once with sherds from 29SJ 724. In fact, these tests showed that differences of identification did exist; especially, of course, in the problem sherds. Although we must acknowledge that the identifications are not completely replicable, we believe that they are adequate to make statements about source and technology of Chaco ceramics within very definite limits.

Although trachyte temper from the Chuska area to the west and crushed andesite/diorite temper from the San Juan River and further north were well known and relatively easy to identify with a binocular microscope, the majority of ceramics found in Chaco Canyon are tempered with some combination of sherd temper and sand or sandstone temper. Determining more specific sources for these combinations was, therefore, extremely desirable. Warren worked on the identification of sandstones through examination of surface sherds from sites in various locations and through hand specimens from outcrops (Warren 1977:18-19). Warren examined in the neighborhood of 90 sherd specimens from Chaco Canyon and other San Juan Basin locations and around 35 slides of sandstone specimens primarily from Chaco Canyon and areas to the south and west. Her microscopic findings are presented primarily in "Technological Studies of the Pottery of Chaco Canyon" (Warren 1976), and "Source Area Studies of Pueblo I-III Pottery of Chaco Canyon, 1976-1977" (Warren 1977).

The job of identifying and analyzing both formations and pottery from an area as large and culturally complex as the Chaco region is, of course, nearly an infinite one. That of analyzing the ceramics recovered by the Chaco Project is another very large undertaking. Realizing that accounting for all the variability present was impossible, the Chaco Project hired me in 1977 to learn the temper types that Warren considered common in order to make temper identifications for the detailed ceramic analysis being conducted by McKenna. The tempers selected were based on a table assembled by Warren (1977:63). Descriptions are presented here one at a time followed by a discussion of how they were used in the analysis and information on their occurrence. Descriptions of the other paste attributes used in the analysis follow the temper discussions.

The temper analysis reported here—that included with the Chaco Project detailed analysis—had three developmental stages and involved two analysts (Tables 2.21, 2.22, and 2.23). The sites analyzed are listed in Table 2.23 in the order in which they were studied.

Using the sandstone cement codes, vitrification, and temper codes, it is possible to organize the data so that all sites have the same data at the same level of detail (a least common denominator). This has been done for overall tables such as those found in the first section of this section (Tables 2.24-2.28). The descriptions that follow present other levels of detail for the sites for which they are available. Attribute states recorded by the various systems may be seen in the forms (Appendix 2A).

Table 2.22 includes the added 29SJ 627 culinary sherds. Because of the temper recording, the table shows items with any sandstone/trachyte mix in one column and items with only trachyte coded in another. Ideally, sherds with more sandstone than trachyte (i.e., sparse trachyte that may well have been introduced through sherd temper) would be shown separately, but this was not estimated for several sites. All sherds coded for <u>any</u> San Juan igneous or unidentified igneous are placed in the columns with those headings. As is true for the rest of the temper data presented in this report, items recorded in temper systems I and II (sites 29SJ 724, 29SJ 628, 29SJ 721, 29SJ 299-PI) as having chalcedonic sandstone cement were converted to the comparable code for the other sites, and the specific formation assignments have been converted to undifferentiated sandstone, again to achieve comparable treatment. There are several things that stand out about 29SJ 1360. Relative to other sites of comparable time period, it has a low incidence of more sherd than sand temper, and it has a very high incidence of chalcedonic sandstone, San Juan igneous, and unidentified igneous. Of the sites in Table 2.23, Shabik'eshchee and 29SJ 1360 were analyzed for temper by McKenna, the rest by Toll. Some of the differences seen in 29SJ 1360 are probably attributable to the temper recorder.

Temper Descriptions

<u>Sedimentary Formations</u>

<u>Undifferentiated Sandstone</u> (Code 200). This category may include the following:

"<u>**Chuska Sandstone**</u>. Tan colored sandstone with white opal cement; medium, rounded grains of colorless quartz, white orange, and green chert and chalcedony, well sorted, massive" (Warren 1977:63).

<u>Age</u>: Tertiary.

<u>Distribution</u>: Underlies the intrusive volcanics of the Chuska Mountains; exposed along much of the eastern slopes of the mountains (Blagbrough 1967; Dane and Bachman 1965; O'Sullivan and Beaumont 1957).

"<u>**Chinle Formation**</u>. White to tan sandstone, medium to coarse rounded grains of high quartz, doubly terminated crystals may be present; icy white feldspar; occasional pink quartz, black grains" (Warren 1977:63).

<u>Age</u>: Triassic.

<u>Distribution</u>: Very widespread, a member of the Glen Canyon Group. In the Chaco region, it outcrops in the Red Mesa Valley and Zuñi Mountains to the south of Chaco, as well as in east central Arizona (Dane and Bachman 1965; O'Sullivan 1977).

"<u>**Ojo Alamo Sandstone**</u>. Coarse, subangular grains of high quartz, orange, gray angular chalcedony, chatoyant white to gray feldspar" (Warren 1977:63).

<u>Age</u>: Tertiary.

<u>Distribution</u>: Outcrops in a band north and east of and parallel to the Chaco River (Baltz et al. 1966; Dane and Bachman 1965; Smith 1983; Wells and Smith 1983).

Table 2.21. Sites analyzed in detailed ceramic analysis.

Site	System I	System II	System IIIa	System IIIb
29SJ 299-PI	-	-	-	504
29SJ 299-BMIII	-	247	-	-
Pueblo Alto	-	-	-	5,380
29SJ 423	-	-	-	637
29SJ 627	-	-	7,518	-
28SJ 628	-	867	-	-
29SJ 629	-	-	-	1,707
29SJ 633	-	-	318	-
29SJ 721	-	143	-	-
29SJ 724	543	-	-	-
29SJ 1360	-	-	-	2,085
29SJ 1659	-	-	-	195
TOTAL	543	1,257	7,836	5,128

"**Mesa Verde Group.** Tan to gray sandstone, fine grained well sorted; miscellaneous clear vitreous quartz; angular gray chalcedony; formations icy white feldspar, sparse pink, orange quartz" (Warren 1977:63).

Age: Cretaceous.

Distribution: Extremely widespread. Forms the outcrops in Chaco Canyon, and some of the outcrops in the Crownpoint area; the Menefee Formation, largely shale but containing some sandstone lenses, is the primary exposed formation for the entire Chaco Basin south of Chaco Canyon. Also exposed north of the San Juan River and, of course, in the Mesa Verde area (Dane and Bachman 1965; Molenaar 1977; Scott et al. 1984; Wells and Smith 1983; Wells et al. 1983). The Transwestern Pipeline Project, which passes 30-40 km west of Chaco Canyon, did extensive testing of Menefee clays showing them to be similar chemically to Cibola series pottery (Bubemyre and Mills 1993:239; Zedeño et al. 1993).

"**Mesa Verde Group, Gallup Sandstone.** Coarse, angular quartz, colorless, smoky; clear to white, gray feldspar; pink, blue quartz may be present; occasionally mica flakes" (Warren 1977:63).

Age: Cretaceous (lowermost unit in the Mesa Verde Group).

Distribution: Outcrops in the Red Mesa Valley and Zuñi Mountain area (i.e., Gallup, NM), and along the Hogback and south of the Chuska Mountains at the west side of the San Juan Basin (Beaumont 1957; Dane and Bachman 1965; Molenaar 1977; Wells et al. 1983).

In addition to the above formations as described by Warren (1977), there are nearly unlimited other possibilities, including sandstones from the Morrison Formation lacking distinctive chalcedonic cement (see below), and other more recent (Tertiary) formations prevalent to the north of Chaco Canyon, such as the Kirtland, Fruitland, and Nacimiento Formations. As a whole, "undifferentiated sandstone" is characterized by a series of superlatives. First, it is the most general code and includes the most cases in these analyses; therefore, it is also the most difficult to define. At its most rudimentary level, this temper code indicates the presence of sand, here nearly always quartz sand. It will be noted that there is no category in the present list for free sand. This absence has two causes, one historical and one practical. Warren was quite insistent that free sand was not incorporated in Anasazi pottery because of a strong historic, and apparently prehistoric tradition of grinding tempers (Shepard 1956:164). This is borne out in many cases through the visible presence of sandstone matrix, or the presence of repeated suites of minerals (Shepard 1956:383). Still, in this analysis at least, use of loose sand cannot be ruled out as a possible temper. Practically, it is difficult to discriminate sand from ground sandstone incorporated in pottery. Sand grains may, of course, be identified as to whether they are aeolian, water lain, or freshly broken. This determination, however, requires both

Table 2.22. Type counts analyzed by temper systems.

Type	System I	System II	System IIIa	System IIIb	Pueblo Alto System[a]
Unidentified Plain Gray	120	237	170	210	29
Lino Gray	65	244	137	207	-
Wide Neckbanded	-	7	160	115	17
Narrow Neckbanded	1	14	308	228	110
PII Corrugated	-	3	566	69	392
PII-PIII Corrugated	-	-	107	6	115
PIII Corrugated	-	1	54	3	46
Unidentified Corrugated	-	16	198	48	1,184
Early PII Neck Corrugated	-	76	116	107	24
Lino Fugitive Red	7	76	7	116	-
Plain Redware	14	9	3	97	4
Polished Tan Gray	-	36	6	496	-
Polished Smudged	49	48	77	87	130
Unfired Mudware	-	6	-	2	4
Exotic Brownware	-	-	3	69	3
BMIII-PI Polished M/w	69	124	94	302	-
BMIII-PI Unpolished M/w	133	144	66	125	2
Early Red Mesa B/w	-	6	155	215	21
Late Red Mesa B/w	1	16	2,323	1,157	314
Escavada B/w	-	1	58	11	142
Puerco B/w	-	-	224	24	285
Gallup B/w	-	6	565	58	1,043
Chaco B/w	-	-	29	3	42
Exotic W/w	-	5	184	69	137
Unidentified Whiteware	-	72	568	338	117
PII-III M/w	-	11	1,094	743	618
BMIII-PI Polished C/w	-	79	35	59	1
BMIII-PI Unpolished C/w	-	70	16	7	-
PII-III C/w	-	5	113	19	98
Mesa Verde B/w	-	-	34	4	4
Chaco McElmo B/w	-	3	3	8	77
Tusayan Whiteware	-	-	45	-	44
Chuska B/w	-	3	25	5	81
Chuska Whiteware	-	1	84	21	138
Chuska Redware	1	2	58	39	29
Decorated Redware	29	11	147	58	129
Polychrome	-	-	4	-	4
Historic	2	-	-	-	-
TOTAL	542	1,256	7,836	5,127	5,380

[a] Pueblo Alto is System IIIb with a few refiring variables added.

expertise and careful examination of individual grains; moreover, determining that a sand grain is aeolian, for example, does not rule out its having come from a sandstone. With this proviso, then, all quartz sand-bearing sherds have been attributed to sandstone tempers.

In the San Juan Basin and much of its periphery, what exposed rock there is, is sandstone. In Chaco Canyon, most of the sandstones are fine to medium-grained and the Cretaceous sandstones that outcrop there have wide areal distribution that is horizontally fairly homogeneous. For temper analysis,

Table 2.23. Sites analyzed by system as part of the detailed ceramic analysis.

Name	Sites	Analyst	Attributes
System I	29SJ 724	Toll	11 specific sources plus general codes, 5 grain sizes, quartz angularity and color, feldspar color, cryptocrystalline color, sandstone cements, other inclusions, sherd temper, vitrification.
System II	29SJ 299-PI 29SJ 721 29SJ 628	Toll Toll Toll	11 formations plus general codes, 6 grain sizes, redefined quartz angularity and color, redefined feldspar and cryptocrystalline colors, redefined sandstone cements, redefined inclusions, sherd temper, clay colors (vitrification included as color attribute).
System IIIa	29SJ 627 29SJ 633	Toll Toll	8 specific sources plus general codes, 4 grain sizes, temper density estimates, paste type groups, sherd temper, p/a vitrification.
System IIIb	29SJ 629 29SJ 423 29SJ 299-BMIII Pueblo Alto Shabik'eshchee (29SJ 1659) 29SJ 1360	Toll Toll Toll Toll McKenna McKenna	As in System IIIa with more codes for estimates of sandstone-igneous mix, degree of vitrification.

these facts have two consequences: 1) it is nearly impossible to pinpoint sources (Shepard 1956:341); and 2) it is substantially harder to identify smaller grains with a binocular microscope than it is to identify larger ones.

Finer grain sizes, however, do not fully account for heavy use of this temper code. The fine grain size exacerbates a problem that was perceived in other sandstone identifications (see below). To identify a specific sandstone complex requires recognizing specific minerals and their relative frequencies. Because most tempers are completely disaggregated and because temper is often sparse (and rare identifying elements thus even rarer), it is probable that many constituents will either be unseen or unidentified. This problem is enhanced when the observer is not trained in petrography (as was the case here), but it is a problem inherent in <u>anyone's</u> analysis. In fact, several geologists expressed some doubt as to the feasibility of reliably identifying sandstone formations <u>even with thin sections</u> (Shepard 1956:167). Thus, while resorting to the category "undifferentiated sandstone" is in some ways shying away from potentially very useful information, it can also be viewed as an exercise in discretion and an avoidance of creating data groups with tenuous factual basis. This is not to imply that such is the case for Warren's groups; her results are explicitly preliminary and remain to be tested and augmented. It <u>is</u> to say the following: 1) that as applied in the Chaco Project analysis in which a binocular microscope was used by an archeologist rather than a petrographer, identification of specific formations is unreliable in the majority of cases; 2) that the composition of sandstones in this very large area is liable to be both horizontally and vertically variable; and 3) that microscopic knowledge of sandstones is at present mostly inadequate for making formation identifications.

In view of these problems, more descriptive recording was sought. The final temper recording system was a compromise involving time expenditure, information content, reliability of identification, and frequency of occurrence. Sandstones that were other than "undifferentiated" were separated on the basis of readily identified constituents and were labelled by criterion rather than by formation. Especially important modifiers of the large sandstone group are grain size and quantity of associated sherd temper. Grain size is attributed considerable source information value by Warren. Because of her finding that sandstones containing coarse-grained quartz

Table 2.24. Distribution of temper by site.

	Temper Type									
Site	Undiff. SS	Sherd >SS	Chalc. SS	Iron Ox. SS	Magnet. SS	San Juan	Trachyte	Trachyte-SS Mix	Unident. Igneous	Total
29SJ 423	495	-	-	46	20	4	1	-	1[a]	567
Shabik'eshchee Village (29SJ 1659)	88	-	-	12	16	-	-	-	1	117
29SJ 299-BMIII	336	14	7	93	7	17	17	2	4[a]	497
29SJ 628	531	4	6	71	39	80	2	1	4	738
29SJ 721	98	3	1	33	3	1	2	1	1	143
29SJ 724	428	5	7	15	16	26	28	4	1	530
29SJ 299-PI	75	30	2	12	3	7	9	1	-	139
29SJ 629	570	661	140	15	20	56	123	47	21[a]	1,653
29SJ 1360	657	381	258	9	15	103	120	63	53	1,659
29SJ 627	2,369	3,248	379	24	70	191	726	394	34	7,435
Pueblo Alto	924	1,125	134	2	20	97	817	610	88[a]	3,817
29SJ 633	47	133	7	-	3	36	31	31	22	310
TOTAL	6,618	5,604	941	332	232	618	1,876	1,154	230	17,605
PERCENT	37.6	31.8	5.3	1.9	1.3	3.5	10.7	6.6	1.3	

The following Tusayan sherds (sandstone temper) are not shown: 29SJ 627—41; Pueblo Alto—26; 29SJ 628—1.

[a] Includes Socorro temper: 29SJ 629—4; Pueblo Alto—5; 29SJ 299-BMIII and 29SJ 423—1 each.

There are 87 specimens with temper unobserved.

Table 2.25. Distribution of type by temper for entire temper analysis sample.

TYPE	Undiffer. Sandstone	Sherd > Sandstone	Chalcedonic Sandstone	Iron Oxide Sandstone	Magnetitic Sandstone	San Juan Igneous	Trachyte	Trachyte-Sandstone Mix	Unidentified Ingeous	Total
GRAYWARE										
Plain Gray	393	16	25	31	22	4	65	5	1	562
Lino Gray	501	3	6	74	39	4	6	4	-	637
Lino Fugitive	132	-	-	45	4	2	-	-	-	183
Obelisk Gray	355	-	1	60	17	3	2	-	-	438
Wide Neckbanded	184	9	56	1	3	3	28	-	-	284
Narrow Neckbanded	367	8	87	3	8	6	122	12	1	614
Neck Corrugated	130	8	29	1	8	2	57	5	-	240
PII Corrugated	358	55	52	3	13	11	340	34	1	867
PII-III Corrugated	83	9	4	-	2	2	94	15	-	209
PIII Corrugated	46	9	4	-	1	5	23	8	-	96
Unidentified Corrugated	411	40	81	2	21	11	457	65	4	1,092
TOTAL GRAYWARE	2,960	157	345	220	138	53	1,194	148	7	5,222
MINERAL-ON-WHITE										
BMIII-PI Polished M/w	353	71	22	23	20	53	19	7	1 *	569
BMIII-PI Unpolished M/w	352	13	12	23	13	42	8	1	3	467
Early Red Mesa B/w	108	198	33	-	-	9	2	15	13 *	378
Red Mesa B/w	905	2,031	330	5	11	58	31	150	49	3,570
Escavada B/w	37	103	7	-	2	1	1	5	1	157
Puerco B/w	83	302	11	-	1	10	10	33	8	458
Gallup B/w	244	665	21	2	6	14	71	323	12	1,358
Chaco B/w	15	32	-	-	-	-	-	23	4	74
PII-III M/w	538	1,146	114	4	11	41	42	150	32 *	2,078
Exotic M/w	64	140	5	-	1	59	28	28	40 *	365
TOTAL MINERAL-ON-WHITE	2,699	4,701	555	57	65	287	212	735	163	9,474

Table 2.25. (continued)

TYPE	Undiffer. Sandstone	Sherd > Sandstone	Chalcedonic Sandstone	Iron Oxide Sandstone	Magnetitic Sandstone	San Juan Igneous	Trachyte	Trachyte-Sandstone Mix	Unidentified Ingeous	Total
CARBON-ON-WHITE										
BMIII-PI Polished C/w	110	3	2	9	3	9	40	8	-	184
BMIII-PI Unpolished C/w	76	-	-	9	2	8	3	1	-	99
Chuskan Red Mesa B/w	2	1	-	-	-	-	87	27	-	117
Chuska B/w	-	-	-	-	-	-	67	23	1	91
Chuska Whiteware	8	1	-	-	-	-	151	60	1	221
Chaco McElmo B/w	20	19	-	-	-	1	2	42	4	88
PII-III C/w	47	72	-	-	-	21	24	52	12	228
Mesa Verde B/w	-	8	-	-	2	15	3	6	6	40
Tusayan Whiteware	67	-	-	-	2	-	2	1	2	74
TOTAL CARBON-ON-WHITE	330	104	2	18	9	54	379	220	26	1,142
Plain Whiteware	349	409	35	20	8	32	57	49	4	963
TOTAL WHITEWARE	3,378	5,214	592	95	82	373	648	1,004	193	11,579
REDWARE										
Plain Redware	74	2	1	14	-	11	6	-	4	112
Decorated Redware	20	96	1	-	-	180	27	2	2	328
Polychrome	-	8	-	-	-	-	-	-	-	8
Polished Smudged	176	124	2	2	10	1	1	-	22	338
TOTAL RED AND SMUDGED	270	230	4	16	10	192	34	2	28	786
Brownware	64	1	-	1	1	-	-	-	2	69
Mudware	11	-	-	-	-	-	-	-	-	11
TOTAL BROWN AND MUDWARE	75	1	-	1	1	-	-	-	2	80
GRAND TOTAL	6,683	5,602	941	332	231	618	1,876	1,154	230	17,667
PERCENT	37.8	31.7	5.3	1.9	1.3	3.5	10.6	6.5	1.3	-

Does not include 90 items with no type or unobservable temper.

[a] Socorro temper: BMIII-PI Polished M/w—1, Early Red Mesa—4, PII-III—1, Exotic mineral—5; Sum—11.

Table 2.26. Distribution of form by temper for entire analysis sample.

Form	Undiffer. Sandstone	Sherd > Sandstone	Chalcedonic Sandstone	Iron Oxide Sandstone	Magnetitic Sandstone	San Juan	Trachyte	Trachyte-Sandstone Mix	Unidentified Igneous	Total
GRAY AND BROWN										
Jar	2,485 [a]	149	331	146	103	48	1,177	145	6	4,590
Pitcher	31	3	3	5	-	1	3	1	-	47
Tecomate	342	2	2	46	28	2	-	-	-	422
Miniature	46	1	-	6	3	2	1	1	-	60
Bowl	28	1	-	6	2	-	-	-	-	37
TOTAL GRAYWARE	1,932	156	336	209	136	53	1,181	147	6	5,156
WHITEWARE										
Bowl	2,454 [b]	3,206	401	89	65	277	341	562	125 [c]	7,520
Ladle	230 [b]	504	66	-	2	24	91	87	26	1,030
Jar	436	865	76	6	10	38	116	195	20 [c]	1,762
Olla	71	226	11	2	2	10	15	45	4	386
Canteen	27 [b]	43	5	1	1	7	4	4	3	95
Pitcher	92	178	13	-	1	13	44	70	8	419
Seed jar	16 [b]	39	5	-	-	5	2	13	2	82
Tecomate	35	25	1	2	-	2	5	4	1	75
Gourd jar	3	3	1	-	-	-	3	4	2 [c]	16
Duck Pot	6	12	2	-	-	-	2	1	-	23
Effigy	12	20	2	1	1	-	1	1	2	40
Miniature	9	18	1	2	-	-	1	6	3	40
Mug/cup	1	-	1	-	-	-	2	-	-	4
Cylinder jar	-	1	-	-	-	-	-	1	-	2
TOTAL WHITEWARE	3,392	5,140	585	103	82	376	627	993	196	11,494
RED AND SMUDGED										
Red bowl	24	94	1	3	-	147	28	2	4	303
Red jar	32	2	1	4	-	25	2	-	1	67
Other red	1	-	-	1	-	4	-	-	-	6
Smudged bowl	164	123	1	2	10	1	1	-	21	323
TOTAL RED AND SMUDGED	221	219	3	10	10	177	31	2	26	699
Pipes	7	1	-	2	-	-	1	-	-	11
GRAND TOTAL	6,552	5,516	924	324	228	606	1,840	1,142	228	17,360

Does not include 311 cases with unknown form and 85 with unobserved temper.

[a] Includes 1 gray seed jar.

[b] There are 65 Tusayan bowls, 1 ladle, 1 canteen, 1 seed jar.

[c] There are 9 Socorro bowls, 1 jar, 1 gourd jar.

Table 2.27. Ware distributions in major temper groups by percent.

Ware	Overall Percent	Sandstone[a]	Chalcedonic Sandstone	San Juan Igneous	Trachyte	Trachyte Plus Sandstone
Grayware	29.6	25.4	36.7	8.6	63.6	12.8
Mineral-on-white	53.6	60.2	59.0	46.4	11.3	63.7
Carbon-on-white	6.5	3.5	0.2	8.7	20.2	19.1
Redware	2.5	1.6	0.2	30.9	1.8	0.8
Total n	17,667	12,285	941	618	1,876	1,154

[a] Sandstone includes all varieties except chalcedonic.

Table 2.28. Form distributions in major temper groups by percent.

Form	Overall Percent	Sandstone[a]	Chalcedonic Sandstone	San Juan Igneous	Trachyte	Trachyte Plus Sandstone
All bowls	43.0	48.1	43.8	70.0	20.2	49.8
All ladles	5.8	6.1	7.1	4.0	5.0	7.7
Whiteware jars	10.0	10.8	8.3	6.3	6.3	17.2
Whiteware pitchers	2.4	2.2	1.3	1.8	2.3	6.2
Whiteware ollas	2.2	3.3	1.2	1.7	0.8	4.0
Grayware jars	26.0	21.8	35.9	8.7	64.3	12.8
Total n	17,360	12,068	918	603	1,833	1,133

[a] Sandstone includes all varieties except chalcedonic.

(more than 0.5 mm) does not outcrop in the canyon proper, Warren considered coarse quartz temper to be indicative of nonlocal production. Coarse-grained deposits exist within 10-25 km of the central canyon, placing them at the upper end of, but still within, ethnographically known ranges for direct acquisition of pottery materials (Arnold 1980:144; 1985:45-49). The Fruitland and the Ojo Alamo Formations, exposed north of the canyon, contain coarse sand and outcrop less than 25 km from the canyon. Nonetheless, acquiring coarse sandstones probably does represent an additional energy expenditure, and many vessels so tempered are unlikely to have been produced in the central canyon area.

Given that identification of formations was largely abandoned, how is this analysis different from merely identifying rock, sand, and sherd as did the many analyses that preceded it? This analysis does make some distinctions in types of sandstones, though not as many as Warren proposed to identify. It also records grain size and estimates quantities of associated sherd temper. Further, this information is recorded for each item in the temper sample and is, therefore, quantifiable.

Differentiations of sandstone temper may also be made according to the amount of associated sherd temper. In Chaco Canyon, the occurrence of sherd temper increases through time. Its heavy use in whitewares is much earlier than in graywares. Heavy use of sherd temper appears so late in graywares as to be more or less inconsequential. While the use of sherd temper has little known source information value, it does imply a difference in production practice, and may thus have some meaning as to location of manufacture. The angularity of sherd temper makes it a better bonding temper than sand (Shepard 1956:132), and the expansion and contraction of sherd temper with heating is more likely to be similar to that of the clay than is quartz (Rye 1976). Thus, there may have been some greater likelihood for the establishment of sherd tempering in areas where sandstone was the primary alternative.

<u>Distributions in the Chaco Sample</u>. For the sake of searching for greater discrimination, the undifferentiated sandstone category has been subdivided four ways in terms of co-occurrence: fine to medium-grained sandstone and coarse to very

coarse sandstone with less than half sherd temper and the same grain sizes with more than half sherd temper (Table 2.29). To treat all sites' ceramics similarly, formation discriminations made for sites processed early in the analysis have been collapsed and made comparable to the recording system used for the majority of sherds in Tables 2.29-2.32. Distributions of the attempted formation divisions are presented following the discussion of the larger undifferentiated category in which many are included.

Trends in the use of tempers from this sandstone group can be seen immediately in Tables 2.29 and 2.30; note that the percentages in the tables are of the total time segment. Important among these trends are the following:

1) A decline in the relative frequency of this sandstone group in all but the redwares and the latest, poorly represented time segment. It should be noted that the use of sandstone at the earlier end of the scale is even greater than the figures in the tables suggest because the occurrence of sandstone categories that have been retained (such as the iron-bearing sandstones) are also relatively high in the early ceramics. In later whiteware types, however, there are many mixed tempers with more sandstone than the other constituent (most notably trachyte). These are treated with the mixed temper here, even though sandstone is the predominant temper.

2) The frequency of sandstone in graywares decreases more dramatically and more rapidly than in whitewares. This is largely a function of the increasing importance of Chuska Graywares in Chaco Canyon (this trend is also clear in the temper distributions in types seen in Table 2.30).

3) The tempers used in graywares are always coarser than those in whitewares, especially after A.D. 800.

4) Sherd temper is relatively infrequent in graywares in all time segments, although it does increase through time.

5) Sherd temper is present in abundance in nearly half of <u>all</u> whitewares from A.D. 920 to 1100 (remember that many sherds in the "less than half sherd temper" group also contain some sherd temper; Table 2.29).

6) The trend to sand and sherd temper in the redwares shows very clearly the shift from a predominance of San Juan Redwares to Tsegi Orange and White Mountain Redwares late in the occupation of Chaco Canyon.

On the whole, vessel forms reflect trends in temper use in wares and through time. Whitewares tend to have finer sandstone and more sherd temper while graywares indicate the opposite (Table 2.31), and earlier pottery has a strong tendency to be coarsely tempered (Table 2.29). The most notable exception is the substantially greater use of coarse temper in whiteware ollas. There is also a higher relative frequency of coarse temper in whiteware bowls, which may be at least partially accounted for by the fact that early types (Basketmaker III-Pueblo I Whitewares) have high relative frequencies of both bowls and coarse sandstone temper (Table 2.29).

The nature of sandstone and sherd temper used can be seen in Table 2.32. As would be true of any temper, smaller quantities of very coarse-grained tempers are necessary for the paste to remain cohesive; thus, coarse-grained sandstones with less than half sherd temper, the second largest sandstone subgroup, constitutes most of the items with low temper density estimates (Table 2.32A). The higher density estimates are dominated by the finer-grained tempers. Eighty percent of all sandstone tempers have density estimates of 10 to 20 percent. Grain sizes also cluster around the midrange in the medium and coarse categories; by far the most common size being medium (Table 2.32B). The combination of sherd temper with undifferentiated sandstone is quite clearly split between coarser and finer grains. Four times more coarse-grained items have less than half sherd temper and most of the larger group have no sherd temper at all. Sherd temper is much more commonly associated with finer tempers. In many ways, this difference reflects temper usage in wares; utility wares have coarse temper and usually do not contain sherd temper and whitewares much more often contain sherd temper and use finer grain sizes (Table 2.32C).

The sites shown in Table 2.33 are roughly in temporal order and the temporal trends seen in Tables 2.29 and 2.30 are reiterated by the site distributions; thus, there is a fairly steady decline in the use of coarse sandstone with less than half sherd temper and

Table 2.29. *Sandstone temper co-occurrences with sandstone broken down into fine-medium and coarse sand grain size and greater than and less than half sherd temper groups; typologically exotic whitewares and polished smudged wares are excluded. Occurrence in terms of percent of total in each time-ware group.*

	Period (A.D.)							
	Pre-800	800-920	920-1040	1040-1100	1100-1200	1200+	Total n	% of Ware
Whiteware								
Fine-medium, <half sherd	15.5	23.8	20.1	13.9	13.4	-	2,665	26.1
Coarse-very coarse, <half	52.9	14.6	4.5	3.8	2.4	-	1,146	11.2
Fine-medium, >half sherd	4.3	30.6	46.1	34.9	24.7	91.7	3,725	36.5
Coarse-very coarse, >half	1.5	4.4	8.3	12.1	6.8	8.3	812	8.0
Fine-medium	19.8	54.4	66.2	48.8	38.1	91.7	-	-
Coarse-very coarse	54.4	19.0	12.8	16.6	9.2	8.3	-	-
% of total	79.6	73.5	79.0	65.5	47.3	100.0	-	81.8
Total n	1,413	294	5,992	1,804	695	12	10,210	
Grayware								
Fine-medium, <half sherd	5.3	6.0	6.4	3.0	5.4	4.3	253	5.1
Coarse-very coarse, <half	74.1	57.7	47.5	32.7	33.5	43.5	2,550	51.7
Fine-medium, >half sherd	.1	1.5	1.0	2.0	2.1	7.2	58	1.2
Coarse-very coarse, >half	.1	1.5	1.4	3.0	1.8	5.8	73	1.5
							2,934	-
% of total	79.6	66.7	56.3	40.7	42.9	60.9	-	59.5
Total n	1,497	336	1,506	1,194	331	69	4,933	
Redware								
Fine-medium, <half sherd	24.0	-	3.6	8.8	9.1	-	43	12.5
Coarse-very coarse, <half	34.9	-	-	-	-	-	45	13.1
Fine-medium, >half sherd	-	10.0	6.3	5.9	72.7	[50.0]	52	15.1
Coarse-very coarse, >half	.8	-	.9	-	14.5	[50.0]	12	3.5
							152	
% of total	59.7	10.0	10.7	14.7	96.4	100.0	-	44.2
Total n	129	10	112	34	55	4	344	

Table 2.30. Occurrence of sandstone temper subdivisions by major type.

GRAIN SIZE:	F-M	C-VC	F-M	C-VC	% Total	Total
SHERD TEMPER:	< half	< half	> half	> half	Type	n
Grayware						
Lino Gray	2.2	76.7	0.5	-	79.4	635
Wide Neckbanded	6.3	58.5	1.4	1.8	68.0	284
Narrow Neckbanded	8.8	51.0	-	1.3	61.1	614
Neck Corrugated	7.5	46.7	1.3	2.1	57.5	240
PII Corrugated	3.7	37.6	3.1	3.2	47.6	867
PII-III Corrugated	5.7	34.0	1.9	2.4	44.0	209
PIII Corrugated	3.1	44.8	5.2	3.1	56.3	96
Mineral-on-white						
BMIII-PI	17.8	55.2	6.1	1.9	76.2	1,036
Early Red Mesa B/w	24.3	4.5	45.2	6.9	81.0	378
Red Mesa B/w	21.7	3.6	49.0	7.9	82.2	3,570
Escavada B/w	8.9	14.6	31.2	34.4	89.2	157
Puerco B/w	12.7	5.2	47.6	18.3	83.8	458
Gallup B/w	13.6	4.3	38.1	10.8	66.9	1,358
Chaco B/w	20.3	-	40.5	2.7	63.5	74
Carbon-on-white						
BMIII-PI	7.1	58.3	0.4	0.7	66.4	283
Chaco McElmo B/w	22.7	-	20.5	1.1	44.3	88
PII-III	17.1	3.5	23.2	8.3	52.2	228
Redware						
Decorated	4.6	1.5	23.8	5.5	35.4	328
Plain	27.7	38.4	0.9	0.9	67.9	112
Polychrome	-	-	[50.0]	[50.0]	[100.0]	4

F-M: fine-to-medium.
C-VC: coarse-to-very coarse.

an increase in finer tempers with more sherd temper. The higher frequencies of "later" tempers in both components of 29SJ 299 reflect the presence of a much later component at that site. The lateness of 29SJ 633 is apparent in the high frequency of coarse-grained temper with more than half sherd temper; a function of the late, sherd-tempered culinary pottery there.

Early Recording Systems and Sandstone "Formation" Identifications. Coarse tempers are far easier to identify using a binocular microscope than are finer ones. Pre-A.D. 900s whitewares and graywares from all periods have coarser, more abundant temper than do most whitewares found in Chaco sites. This is not an esoteric fact, but it had considerable impact on the development of the Chaco Project paste analysis. The project's excavation program was chronologically structured so that the earliest sites were excavated earliest in the program. Thus, collections which had been in the analytical backlog longest were early sites. Additionally, the collections were of more manageable proportions than the much larger 29SJ 627 and Pueblo Alto samples.

These earlier sites were those used for pilot analyses and are, thus, the sites for which attempts at more specific sandstone temper identifications exist. While these identifications have already been labelled as potentially suspect, a summary of their distribution

Table 2.31. Vessel forms of sandstone temper subdivisions.

	F-M < half %	C-VC < half %	F-M > half %	C-VC > half %	% of Total Form %	Total n
A. Occurrence by major vessel form (% of form)						
Whiteware bowl	18.5	13.3	35.0	7.6	74.4	7,520
Ladle	16.3	6.0	39.9	8.9	71.2	1,030
Whiteware pitcher	19.3	2.6	36.5	6.0	64.4	419
Whiteware olla	14.5	3.9	43.0	15.5	76.9	386
Whiteware jar	17.6	7.2	40.3	8.8	73.8	1,762
Grayware jar	6.3	47.8	1.5	1.7	57.3	4,589
B. Forms as % of temper					% Temper Sample	% Total Sample
Whiteware bowl	54.9	25.3	58.8	55.1	46.6	43.3
Ladle	6.6	1.6	9.2	8.9	6.1	5.9
Whiteware pitcher	3.2	0.3	3.4	2.4	2.3	2.4
Whiteware olla	2.2	0.4	3.7	5.8	2.5	2.2
Whiteware jar	12.2	3.2	15.9	15.0	10.8	10.1
Grayware jar	11.4	55.6	1.5	7.6	21.9	26.4
% of temper shown	90.5	86.4	92.5	94.8	90.2	90.3
Total n	2,538	3,948	4,479	1,032	11,997	17,361

Each entry in Part A is the number of a form with a temper combination divided by the total number of that form in the temper sample (e.g., 1,391 of 7,520 whiteware bowls have fine-medium sandstone temper and less than half sherd temper, or 18.5%; 74.4% of all whiteware bowls in the temper sample have some form of sandstone temper).

Part B shows the percent of a temper combination that is found in specific forms; e.g., 6.6% of fine-to-medium sandstone with less than half sherd temper occurs in ladles. The last column in B shows form percentages for the total detailed sample; "% of temper shown" row indicates the amount of each temper group in the major form categories included in this table.

FM: fine-to-medium.
C-VC: coarse-to-very coarse.

is presented here to convey not only what information it suggests about resource use but also some idea of the constituents of sandstone temper complexes observed in the early Chaco material. The early temper recording systems recorded both formation identifications and the following backup information: quartz angularity, quartz color, feldspar color, cryptocrystalline color, and type of sandstone cement. The rationale behind this recording was to show the basis for the formation assignment. While such information is archivally useful and might allow for subsequent refinement in source identification, it was time-consuming to collect and, pragmatically, its future potential seemed small. For example, it would have been possible to know how many Ojo Alamo identifications were based on the presence of "moonstone," but occurrences of moonstone would invariably be with Ojo Alamo identifications leading to much redundant information. More importantly, in a large number of later specimens with finer temper, most of these categories are unobservable. The complete deletion of some of these complexes of minerals as specified by formation names may have been an over-reaction to the perceived difficulty of identifying formations. Retaining a few descriptive complexes such as coarse, angular quartz with gray feldspar ("Gallup Sandstone"), without a formation assigned, might have had some present and potential value.

The distribution of the formation records for site 29SJ 724, 29SJ 299-PI, 29SJ 628 and 29SJ 721 are shown in Tables 2.34 and 2.35. Grain size is clearly a criterion in formation assignment (Table 2.36) and occurrences of formation codes; therefore, grain size relates to ware distributions as well (Table

Table 2.32. Sandstone temper co-occurrence with other paste attributes.

GRAIN SIZE: SHERD TEMPER:	F-M < half	C-VC < half	F-M > half	C-VC > half	Total n
A. Temper density					
1-2%	19.5	55.6	13.0	11.8	169
5%	18.0	50.2	21.1	10.7	1,674
10%	17.6	37.5	34.8	10.1	4,283
20%	25.1	10.2	56.4	8.3	2,957
30%	42.5	1.3	53.2	2.9	616
40% or more	93.0	-	7.0	-	128
Total estimated %	22.5	29.0	39.4	9.1	-
Total n	2,210	2.85 1	3,869	897	9,827
Overall %	21.2	33.0	37.3	8.5	-
Overall n	2,588	4,032	4,558	1,041	12,219
B. Grain size breakdown					
	Fine	Medium	Coarse	Very Coarse	Total n
Fine SS < half sherd	33.2	66.8	-	-	2,586
Coarse SS < half sherd	-	-	66.4	33.6	4,031
Fine SS > half sherd	26.8	73.2	-	-	4,558
Coarse SS > half sherd	-	-	96.4	3.6	1,041
% of total	17.0	41.4	30.1	11.4	12,216
C. Sherd temper breakdown					
	None	< half	> half	All	Total n
Fine SS < half sherd	41.6	58.4	-	-	2,585
Coarse SS < half sherd	88.5	11.5	-	-	4,032
Fine SS > half sherd	-	-	93.7	6.7	4,557
Coarse SS > half sherd	-	-	92.1	7.9	1,041
% of total	38.0	16.2	42.8	3.0	12,215

FM: fine-to-medium.
C-VC: coarse-to-very coarse.

2.34). Thus, the coarse-grained formations (Ojo Alamo, Morrison, and Gallup) are relatively more abundant in graywares and early whitewares, while Mesa Verde and undifferentiated sandstones are more abundant in whitewares and redwares. The difference is not as striking as it might be because of the high frequency of Basketmaker III-Pueblo I Whitewares at these sites, which contain especially high percentages of Gallup Sandstone (Table 2.34). Gallup Sandstone was coded as often as undifferentiated sandstone. Of the formations tentatively identified, outcrops of Gallup Sandstone are more extensive in areas near Chaco Canyon with substantial known Anasazi populations than are the other formations (Figure 2.8). All these outcrops are, however, at considerable distance from Chaco Canyon (more than 60 km). Ojo Alamo, the closest major formation containing coarse-grained sandstone, is also abundant in these counts occurring in proportions similar to Gallup, though with slightly higher relative frequencies in the graywares. The Morrison and Chinle Formations, both considered likely to represent sources south of Chaco Canyon, are less abundant, though together, they constitute about 8 percent of the total sample. The grain size effect is again apparent, with a slightly higher

Table 2.33. Sandstone temper site occurrence as a percent of each site's total temper sample.

GRAIN SIZE:	F-M	C-VC	F-M	C-VC		
SHERD TEMPER:	< half	< half	> half	> half	Total n	Site %
Shabik'eshchee	10.3	65.0	-	-	117	75.2
29SJ 423	28.4	58.9	-	-	567	87.3
29SJ 299 BMIII	10.3	57.3	2.4	-	497	70.0
29SJ 628	5.1	66.8	0.3	-	740	72.3
29SJ 299 PI	9.4	44.6	12.2	9.4	139	75.5
29SJ 721	7.7	60.8	0.7	1.4	143	70.6
29SJ 724	18.5	62.4	0.4	0.6	529	81.9
29SJ 629	18.3	16.2	33.6	6.4	1,653	74.5
29SJ 1360	22.7	17.2	21.0	1.9	1,660	62.5
29SJ 627	14.4	17.3	35.3	8.1	7,476	75.1
Pueblo Alto	11.2	12.8	23.1	6.2	3,843	53.3
29SJ 633	6.8	8.4	29.0	13.9	310	58.1
Temper total n	2,588	4,032	4,558	1,041	12,219	

F-M: fine-to-medium.
C-VC: coarse-to-very coarse.

percentage of the coarser Morrison sandstone in graywares and the finer Chinle Sandstone somewhat more frequent in whitewares. Interestingly, though tentative identifications of Morrison Sandstone total 65, there are only 16 cases in which chalcedonic cement was recognized, though this cement in Warren's definitions was a "common" constituent of Morrison Sandstones (see below). Sandstone containing rounded iron oxide (also discussed below), is quite common in these early types, especially in Lino Gray.

Occurrence at sites (Table 2.37) shows some apparent "preference" at different sites. Ojo Alamo and Chinle Sandstones are somewhat more abundant at 29SJ 724; Morrison and iron oxide sandstones are more common at 29SJ 721 and 29SJ 628, and undifferentiated and Mesa Verde Sandstones are more common at 29SJ 299-PI, perhaps reflecting a somewhat later date. The common sandstones are well represented at all four sites.

Chalcedonic Cement Sandstone (Code 230, 231).

"Morrison Formation, Prewitt Member. Tan to red sandstone; pink orange chalcedonic cement common; medium to very coarse, rounded to subangular, often polished, grains of high quartz, light gray chalcedony, white kaolin and orange feldspar" (Warren 1977:63).

Age: Jurassic.

Distribution: The Morrison Formation as a whole is extremely widespread, outcropping in many parts of Colorado, Utah, Arizona, and New Mexico (Craig et al. 1955; Smith 1967). In the Chaco region there are exposures in the Red Mesa Valley, the Laguna area, along the western edge of the San Juan Basin—both south and north of the Chuska Mountains—and extending past the Four Corners (Dane and Bachman 1965; Smith 1967). The Prewitt Member is equivalent to the Westwater Canyon Member (Lochman-Balk 1967), but Smith (1967) has differentiated it in the Red Mesa Valley as possibly having a local source. Various members of the Morrison Formation form cliffs and slopes in the Red Mesa Valley (Saucier 1967; O'Sullivan and Beaumont 1957), with coarse-grained facies outcropping in the Thoreau and Gallup areas (Kelly 1977). Warren (1976:22, 30; 1977:38) reports outcrops of this particular sandstone in the Rio Puerco of the East. The Brushy Basin members of the Morrison Formation are known east of Grants, New Mexico, and near Smith Lake, south of Chaco Canyon.

As used in this analysis, the presence of chalcedonic cement was required for this temper to be coded. In the most obvious cases, this temper appears as fragments of cement that have clearly been broken, with cement adhering to sand grains or

Table 2.34. Type distribution of recorded sandstone formation temper from sites 29SJ 724, 29SJ 299-PI, 29SJ 628, and 29SJ 721.

	Undiffer.	Mesa-Verde	Morrison Formation	Chinle	Ojo Alamo	Chalce-donic	Gallup	Iron Oxide	Magnetitic
Grayware									
Plain Gray	50	-	6	15	46	1	48	19	8
Lino Gray	59	-	22	2	79	1	70	43	19
Lino Fugitive	11	-	3	-	16	-	20	12	3
Obelisk Gray	5	-	5	1	6	1	1	11	-
All Neckbanded	-	-	-	1	2	1	2	1	-
All Corrugated	2	-	-	2	1	2	-	-	-
Subtotal	127+	-	36	21	150	6	141	86	30
Whiteware									
BMIII-PI Mineral	89	22	13	24	84	5	128	19	14
BMIII-PI Carbon	30	3	9	1	31	2	56	17	5
All Red Mesa	10	8	-	1	-	-	2	-	-
All PII-III Mineral[a]	12	2	-	2	1	1	1	-	1
Unidentified White	22	2	4	2	17	-	16	5	-
Subtotal	417	37	26	30	133	8	203	41	20
Red and Smudged Wares									
Plain Redware	4	-	-	-	2	1	2	4	-
Decorated Redware	6	-	-	-	1	1	-	-	-
Polished Smudged[b]	50	10	3	4	5	-	6	1	10
Subtotal	60	10	3	4	8	2	8	5	10
TOTAL	350	47	65	55	291	16	352	132	60
Percent of sandstone	25.6	3.4	4.8	4.0	21.3	1.2	25.7	9.6	4.4
Percent of total	22.6	3.0	4.2	3.6	18.8	1.0	22.7	8.5	3.9

Not shown: 178 non-sandstone tempered items and 5 late carbons, 6 mudware, 4 exotic mineral-on-white, and 2 Navajo.

[a] Includes Escavada and Gallup Black-on-white and PII-III Mineral-on-white.

[b] Coarse sandstone-tempered polished smudged is considered here to be Lino Smudged.

Table 2.35. Occurrence of recorded sandstone formations in vessel forms.

Form	Undiffer.	Mesa Verde	Morrison Formation	Chinle	Ojo Alamo	Chalce-donic	Gallup	Iron Oxide	Magnetitic
Whiteware bowl	137	28	26	24	122	6	193	43	19
Ladle	3	1	-	-	-	-	1	-	-
Whiteware closed	28	9	1	5	11	2	5	4	1
Whiteware olla	1	-	3	-	2	-	8	3	1
White and gray tecomate	51	-	16	-	61	1	52	3	1
Redware bowl	6	-	-	-	3	1	2	3	-
Redware jar and tecomate	4	-	-	-	-	-	-	1	-
Grayware jar	64	-	14	20	84	4	81	50	16
Grayware pitcher	3	-	-	-	1	-	1	2	-
Polished smudged bowl	50	10	3	4	5	-	6	1	10
TOTAL	347	48	63	53	289	14	349	110	48
PERCENT	22.8	3.2	4.1	3.5	19.0	0.9	22.9	7.2	3.2

Table 2.36. Grain sizes of identified sandstone formations.

Grain size	Undiffer.	Mesa Verde	Morrison Formation	Chinle	Ojo Alamo	Chalcedonic	Gallup	Iron Oxide	Magnetitic
Very fine	7	-	-	-	-	-	-	-	1
Fine	18	14	-	1	2	-	-	-	5
Medium	56	33	3	14	22	3	12	-	8
Medium-to-coarse	144	1	28	30	118	9	127	28	21
Coarse	102	-	30	9	104	-	131	63	18
Very coarse	33	-	4	1	47	-	81	41	8
TOTAL	360	48	65	55	293	12	351	132	61

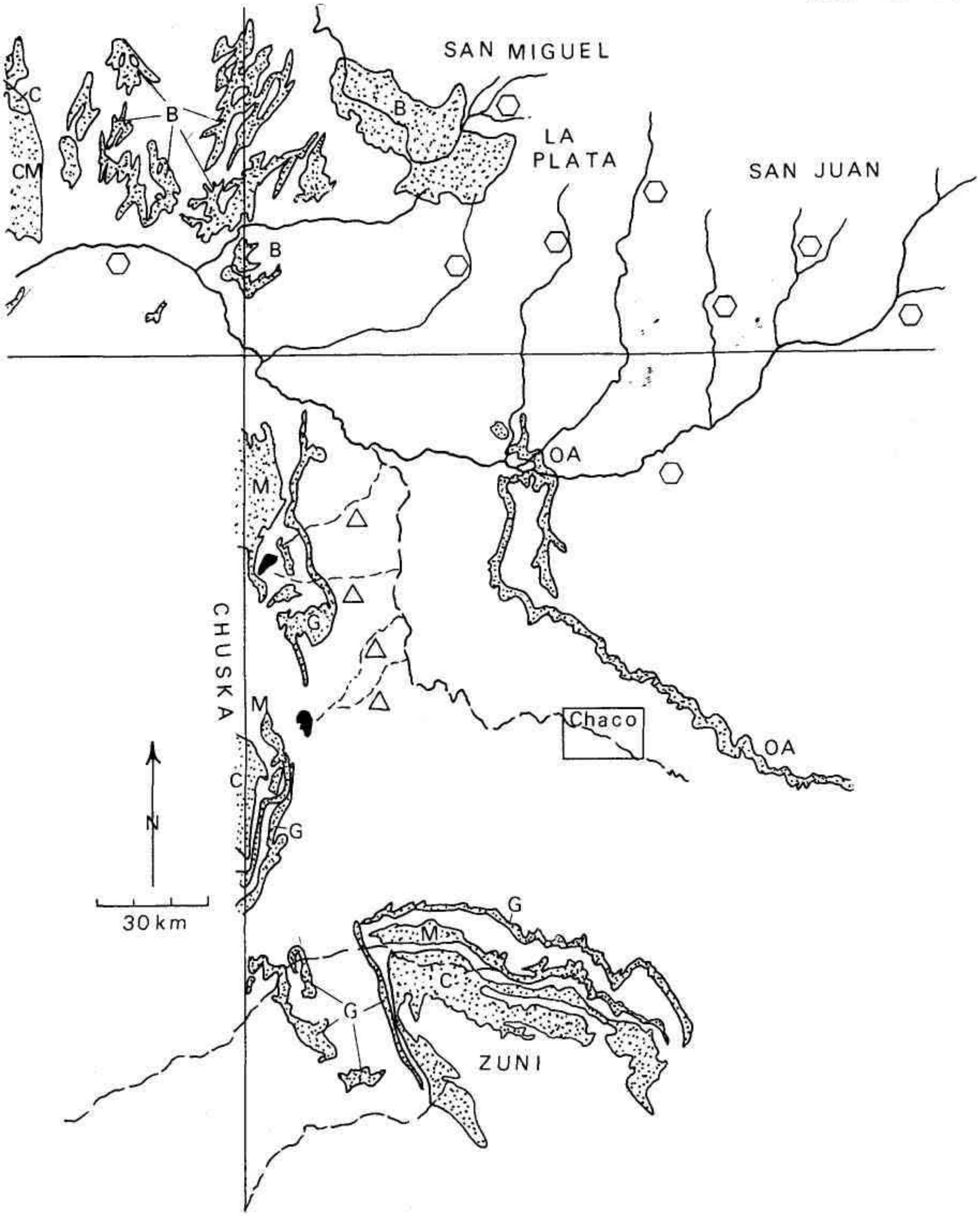


Figure 2.8. *Map of temper material occurrence in the Chaco region showing locations of igneous temper materials and major outcrops of formations containing coarse-grained sandstone. Mountain ranges are in capital letters; formations are indicated by initials: G=Gallup, OA=Ojo Alamo, M=Morrison, C=Chinle, CM=Cedar Mesa, and B=Burro Canyon. Trachyte outcrops are shown as solid areas in the Chuska Mountains with triangles indicating washes containing trachyte. Drainages containing San Juan igneous rocks are indicated by hexagons. After Dane and Bachman (1965) and Haynes et al. (1972).*

Table 2.37. Site distributions of identified sandstone formations.

Site	Undiffer.	Mesa Verde	Morrison Formation	Chinle	Ojo Alamo	Chalcedonic	Gallup	Iron Oxide	Magnetitic
29SJ 299-PI	42	15	3	5	14	2	26	12	3
29SJ 628	184	7	34	13	122	6	175	72	39
29SJ 721	28	4	13	3	27	1	26	33	3
29SJ 724	107	22	15	34	130	7	125	15	16
TOTAL	361	48	65	55	293	16	352	132	61
Percent of total	23.3	3.1	4.2	3.5	18.9	1.0	22.7	8.5	3.9

retaining the shape of a detached grain [see color microfiche slide 1-2-24-82 #24]. In less obvious cases, identification hinged on reasonable confidence that fragments of cement were present. This was in keeping with Warren's earlier description of the temper that "arcuate fragments of milky white to light pink or pinkish-orange chalcedony are diagnostic" (1976:29). It should be noted that especially in subsequent analyses, Warren used criteria other than this cement to specify the Morrison Formation, such as cryptocrystalline grains and feldspars, which were not considered in the final recording system here.

In the Chaco Project analysis, two varieties of sandstone with chalcedonic cement were identified in the coding, based on the color of the cement. As described by Warren above, the most distinctive variety is pink (Code 230). The pink apparently grades to white, and because this color difference could eventually be found to relate to provenance, the two were kept separate for the Pueblo Alto, 29SJ 629, 29SJ 1360, 29SJ 423, and 29SJ 299-BMIII samples (not for 29SJ 633 or 29SJ 627). This difference between white and pink is also important because of security of identification. While there are few inclusions that are likely to look like the pink cement, it is possible that several other items might be confused with the white cement, especially when the temper is fine. Chuska Sandstone, which was rarely identified either by Warren (1976, 1977) or by my attempts to differentiate tempers, also has white "opaline" cement (see Warren's description above under undifferentiated sandstone). Portions of some crushed rock temper, but especially sherd tempers, are white and might be confused with white chalcedonic cement.

Because this temper is numerically important in Chaco Canyon ceramic analyses and because we thought it could be identified in our analysis, its geological source is of considerable interest. Warren (1977) attributes it to the Red Mesa Valley, based on finding higher frequencies of it in surface sherds there than anywhere else. None of several geological descriptions (Kelly 1977:285; Martinez 1979:32-36; Saucier 1967:141-144; Smith 1967:135) mention chalcedonic cement in their descriptions of the Prewitt/Westwater Canyon member, or in the other Morrison members. Martinez (1979) does mention silica cement; his descriptions of sections and petrology between Gallup and Laguna are good examples of the variation in both grain size and composition of sandstone formations. Stephen Post (then of the School of American Research—SAR) consciously looked for this cement in 100 sherds from some excavations at the outlier community called the Andrews Group (near the modern town of Prewitt), but found this temper in only two sherds. Moreover, Dick Lang, also of the SAR, recalled none from around 1,000 culinary sherds from the same area (S. Post, personal communication, 1984; Post 1985a). Post (1985b) did identify this temper in substantial numbers of sherds he examined from 29SJ 626, so this is not a definition or a recognition problem. Post (1985b) also examined sherds from several sites along Interstate-40, from west of Prewitt to just west of the Continental Divide. Chalcedonic cement was the temper used in nearly half of the pottery he examined from LA 47499 at the Continental Divide—far higher frequencies than in sherds from sites near the Andrews Group. William Lucius (personal communication, ca. 1982), who has worked mainly with ceramics from north of Chaco Canyon, notes the occurrence of a temper sounding very much like this one, as does Winston Hurst (personal communication, 1979) who examined tempers in the Rio Puerco of the East around Guadalupe Ruin, also a Chaco outlier.

Based on Warren's and Post's findings, we continue to consider this temper as possibly representing an area south of Chaco Canyon, but its source must be considered largely unknown. Post's (1985b) work indicates the importance of remembering that, even if this material is from the Prewitt Member, it is probably not from from the Prewitt end of the Red Mesa Valley, but from nearer Thoreau. Its apparently patchy distribution and the lack of mention in general geological descriptions of the formation suggest that if it does occur in the Morrison Formation, it may be in the form of isolated outcrops. Whatever the formation or location of the outcrops—especially if they are limited in extent—will provide new detail on the timing and scope of the Chaco economic system.

Saucier (1967:141) notes the presence of substantial quantities of volcanic materials in specimens from the Westwater Canyon Member. In a thin-section analysis of 32 sherds from Chaco Canyon, G. Chandler found pumice in five specimens (P. Rosenberg, personal communication, 1981). Though our analysis identified two of the 32 as having chalcedonic sandstone temper, neither of these sherds contained pumice. It may be as Warren suggested, then, that Morrison Formation materials were being used for pottery. The thin-section analysis recorded 10 percent and 29 percent of the temper as being "cement" for the two sherds we recorded as having chalcedonic cement sandstone. Their analysis noted "cement" in 17 other sherds, mostly in the 1 to 5 percent of temper range, but with one other example rated at 21 percent. Since the type of cement is unspecified, these occurrences could easily be other kinds of sandstone cement. This occurrence in over half of the sherds gives support to Warren's argument for the use of sandstone temper. What all of these findings show best is that ceramic sources are probably much more complex than the results of this analysis may superficially suggest.

Occurrence in the Chaco Sample. As can be seen in Tables 2.24-2.26, chalcedonic sandstone constitutes about 5 percent of the total temper sample and is the fifth most abundant of the broad temper categories used in those tables. Its relative frequency at 29SJ 1360 is 16 percent, which is much higher than the more or less contemporary sites 29SJ 629 and 29SJ 627. This may have to do, in part, with difference in temper analysts. Much of the difference in occurrence is between white cement and fine-tempered whitewares, suggesting the possibility of some confusion of sherd temper with sandstone cement (McKenna and Toll 1984:129-130). The ceramic assemblage of 29SJ 626 is very similar to these three sites, and chalcedonic sandstone occurs in similar frequencies to the Chaco Project sample (e.g., 12 percent in neckbanded, 3 percent in corrugated; Post 1985b:25, 27).

Table 2.38 shows forms and types in which chalcedonic sandstone was found. The type distribution shows quite clearly that this temper tends to be most abundant in the A.D. 920 to 1040 time range. About 65 percent of it is from types in that period or earlier and the percentage is probably higher, given the large numbers of unidentified corrugated and Pueblo II-III Mineral-on-white, both of which are likely to contain many members of vessels that would

Table 2.38. Type by vessel form for chalcedonic cement sandstone.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed[a]	Total
Plain Gray	-	1	16	-	-	-	17
Lino Gray	-	-	3	1	-	2	6
Wide Neckbanded	-	-	56	-	-	-	56
Narrow Neckbanded	-	-	86	1	-	-	87
Neck Corrugated	-	-	28	1	-	-	29
PII Corrugated	-	-	52	-	-	-	52
PII-III, III Corrugated	-	-	8	-	-	-	8
Unidentified Corrugated	-	-	81	-	-	-	81
Grayware	-	1	330	3	-	2	336
BMIII-PI M/w	22	2	8	-	-	2	34
BMIII-PI C/w	1	-	1	-	-	-	2
Early Red Mesa B/w	27	2	3	-	1	-	33
Red Mesa B/w	250	36	24	5	6	8	329
Escavada B/w	5	1	-	-	-	1	7
Puerco B/w	5	1	4	-	-	1	11
Gallup B/w	14	3	2	-	1	1	21
PII-III M/w	58	18	23	6	2	1	108
Unidentified Whiteware	16	1	11	1	1	-	30
PII-III Exotic M/w	3	1	-	-	-	1	5
Whiteware	401	65	76	12	11	15	580
Redware	1	-	1	-	-	-	2
TOTAL	402	66	407	15	11	17	918
Percent	43.8	7.2	44.3	1.6	1.2	1.9	

[a] Closed forms include: canteens (5), duck pots (2), mugs (1), seed jars (5), tecomates (3), and gourd jars (1).
Not shown: 1 PI-III mineral miniature, 2 effigies (plain gray and Red Mesa), and 16 unknown vessel forms.

be classified as Pueblo II or neck-corrugated and Red Mesa Black-on-white, respectively. In later contexts (such as Pueblo Alto), this temper is more common in Pueblo II Corrugated than in whitewares. Overall, the percentage of grayware is higher than in the overall sample, suggesting that, as with the Chuska area, there may have been some emphasis on bringing graywares from this source. In keeping with the high grayware frequency, over 40 percent of the chalcedonic sandstone present is coarse or very coarse-grained. Use of sherd temper with chalcedonic sandstone is considerably less than in the undifferentiated category with 75 percent having less than half sherd temper. Except for two early specimens, chalcedonic sandstone was not found in carbon-painted wares.

Table 2.39 shows the occurrence of pink and white cement varieties at the four sites where the distinction was made. The white is twice as abundant as the pink (see the discussion of 29SJ 1360 above), except at Pueblo Alto, where apparently because of its later date, the chalcedonic sandstone is more often found in graywares. Note that the two cements are evenly split in the graywares while the whitewares are 78 percent white cement. Perhaps, then, there was either selection for a specific variety of sandstone for whitewares or, more likely, perhaps this temper represents at least two areas, with that represented by the pink cement producing more grayware and producing later into the sequence.

Sandstone with Rounded Iron Oxide here (Code 255) "Sandstone, late Tertiary? "Buffalo Springs." "...tan, very coarse grained, friable sandstone; clear colorless [quartz], also high quartz with crystals; orange pink feldspar; rounded iron oxide grains..." (Warren 1977:63).

Age: Tertiary or Pleistocene.

Distribution: Not geologically mapped, but several occurrences have been noted which are probably related to this temper type. Love et al.

Table 2.39. Chalcedonic sandstone cement colors for types, forms, and sites from 29SJ 299-BMIII, 29SJ 423, 29SJ 1360, and Pueblo Alto.

	Pink	White	Total
TYPES			
Plain and Lino Gray	5	8	13
Wide Neckbanded	12	10	22
Narrow Neckbanded	17	28	45
Neck Corrugated	7	15	22
PII Corrugated	14	10	24
PII-III and III Corrugated	2	-	2
Unidentified Corrugated	39	28	67
BMIII-PI Mineral/white	3	19	22
Early Red Mesa Black-on-white	3	21	24
Red Mesa Black-on-white	33	141	174
Puerco and Escavada Black-on-white	5	7	12
Gallup Black-on-white	6	10	16
PII-III Mineral/white	20	54	74
Unidentified Whiteware	7	10	17
Exotic Mineral/white	-	3	3
Polished Smudged	-	2	2
TOTAL	173	366	539
FORMS			
Whiteware bowl	53	175	228
Ladle	5	33	38
Pitcher	3	5	8
Olla	2	6	8
Whiteware jar	12	37	49
Other closed whiteware	1	8	9
Mini, mug, effigy	1	2	3
Gray jar and pitcher	96	97	193
Smudged bowl	-	1	1
TOTAL	173	364	537
SITES			
29SJ 299-BMIII	1	6	7
29SJ 629	33	107	140
29SJ 1360	65	193	258
Pueblo Alto	74	60	134
TOTAL	173	366	539

(1983:20) note Pleistocene deposits at the base of the cliffs near Wijiji. Deposits containing coarse-grained quartz and rounded iron oxide, cemented with white to tan (calcareous?) matrix are present on the top and sides of the low bench on which Casa Rinconada is located, and on the canyon floor on the north side of the canyon near Peñasco Blanco. From his time spent in the Chaco region, R. W. Loose (personal communication, ca. 1980) thought that these late deposits were common in the San Juan Basin.

Warren had hand specimens from West Mesa in Chaco Canyon, from the Chaco Wash near La Vida Mission (Lake Valley, NM), and from Buffalo Springs in the vicinity of Tohatchi, NM (Warren 1977:37).

This temper was identified primarily on the basis of the presence of rounded iron oxide. These particles are a dark red-brown, usually around a millimeter in diameter and soft enough to be scratched with a needle. They have the appearance of tiny, water-rounded concretions ranging in size from about 0.5 to 1.5 mm. As noted by Warren, the associated quartz is coarse and it is my impression that there are frequently other constituents, including some colored feldspars and cryptocrystallines. During the analysis of the 29SJ 299-BMIII sherds, it seemed probable that there were substantial numbers of cases which contained the same materials with no rounded iron oxide visible. These cases were coded as undifferentiated sandstone rather than as iron oxide sandstone. There were 55 such cases in this category, as compared to 93 cases coded for iron oxide.

It is possible that a tempering material similar to this one was available from ant hills in Chaco Canyon. Ants seem to prefer coarse materials on the surfaces of their mounds and these materials seem often to include fragments of concretions (Windes 1993). In many cases, the coarse grains are fragments of fine-grained sandstone but coarse quartz is also sometimes visible (Gauthier [1982] mentions ant hills as a temper source in the Ojo Caliente area as well). In the Casa Rinconada area, substantial quantities of loose coarse-grained material containing rounded iron oxide is available on the surface.

<u>Occurrence in the Chaco Sample</u>. Rounded iron oxide sandstone temper has a very striking association with early types and forms in Chaco Canyon sites (Table 2.40). Of the cases placed by type and provenience (n=315), 90 percent are in the earliest time group and 50 percent are from the 29SJ 299-BMIII component and 29SJ 628. Over half of the cases recorded (primarily jars and large tecomates) occur in three early grayware variants: unpolished (Lino), polished (Obelisk) and those with fugitive red wash (Lino Fugitive). This temper also occurs in painted wares, evenly split between polished and unpolished vessels; apparently, considerably more often in association with mineral as opposed to organic paint. Decorated wares are less abundant in earlier than later deposits, which is reflected in the greater frequency of this temper in graywares than in white. Given the possibility that rounded iron oxide sandstone was a locally available temper, it is of interest that there are 14 (4.4 percent of the temper) early redware vessels represented. It is thought that in later periods all redwares came from well outside Chaco Canyon, though, as above, similar material is apparently widely enough distributed that some of these vessels may well have been made elsewhere. It also seems noteworthy that of the few post-A.D. 900 whitewares (a total of 14, 11 of which are whiteware), two are miniatures and seven are bowls suggesting a limited and perhaps <u>ad hoc</u> local potting use later in time, perhaps by individuals not accustomed to ceramic production.

Only ten of the 322 recorded cases contain any sherd temper at all, fitting with both the early types and the predominance of grayware. Ninety percent of the cases are coarse or very coarse-grained with the smallest grain size recorded being medium (ca. 0.5 mm). Quite often, this temper was associated with tan clays lacking a carbon streak.

<u>Magnetitic Sandstone</u> (Code 292). This temper is characterized by brown to black sandstone cement. It occurs either as staining of quartz grains or as fragments of sandstone showing the cement. There is a range of quartz sizes from fine to coarse.

<u>Age</u>: Unknown; possibly Cretaceous Menefee (Warren 1976:32).

<u>Distribution</u>: Unknown. If from the Menefee Formation, it could be from a very broad area ranging from Chaco Canyon to the south, though it must occur as pockets in this widely exposed formation. Warren (1976) suggests that this temper may also come from the Naschitti area on the western edge of the San Juan Basin.

This sandstone was not included in the master list from Warren (1977:63), but was retained because of its distinctive appearance and security of identification. The Menefee Formation has abundant outcrops of usable potting clay so that occurrence of some pottery using both temper and clay materials

Table 2.40. Type by vessel form for rounded iron oxide sandstone temper.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed*	Total
Plain Gray	2	-	25	-	-	-	27
Lino Gray	2	-	25	3	2	38	70
Lino Fugitive	1	-	38	2	4	-	45
Obelisk Gray'	1	-	48	-	-	8	57
Wide Neckbanded	-	-	1	-	-	-	1
Narrow Neckbanded	-	-	3	-	-	-	3
Neck Corrugated	-	-	1	-	-	-	1
PII Corrugated	-	-	3	-	-	-	3
Unident. Corrugated	-	-	2	-	-	-	2
Grayware	6	-	146	5	6	46	209
BMIII-PI Polished M/w	20	-	2	-	-	1	23
BMIII-PI Unpolished M/w	21	-	2	-	-	-	23
BMIII-PI Polished C/w	9	-	-	-	-	-	9
BMIII-PI Unpolished C/w	9	-	-	-	-	-	9
Red Mesa B/w	5	-	-	-	-	-	5
Gallup B/w	1	-	-	-	-	-	1
PII-III M/w	1	-	-	-	1	1	3
Unident. White	18	-	2	-	-	-	20
Whiteware	84	-	6	-	1	2	93
Plain Redware	8	-	4	-	1	1	14
Polished Smudged	2	-	-	-	-	-	2
Brownware	-	-	-	-	-	1	1
Red and Brownwares	10	-	4	-	1	2	17
TOTAL	100	-	156	5	8	50	319
Percent	31.3	-	48.9	1.6	2.5	15.7	

* Closed for this temper includes 49 tecomates and 1 canteen (PII-III Mineral-on-white).

Not shown are 2 pipes (Lino and Obelisk Gray), 2 miniatures (PII-III Mineral-on-white and Gallup Black-on-white), and 1 effigy (plain gray).

from the Menefee makes sense (see also Zedeño et al. 1993:227).

Occurrence in the Chaco Sample. Warren (1976) notes this material in early contexts and, while it is also recorded most often in early sherds in the present analysis, magnetitic sandstone remained in use longer than rounded iron oxide sandstone (Table 2.41). Magnetitic sandstone is never a large proportion of the temper at any site or in any type, although it reaches 13.7 percent of the Shabik'eshchee (29SJ 1659) sample and 5.3 percent of the 29SJ 628 sample. It is always more common in graywares. Seventy-five percent of the cases reported here have coarse-grained quartz, as would be expected from early dates and grayware preference. With the exception of its somewhat greater occurrence in later types, its distribution is very similar to that of rounded iron oxide sandstone, suggesting a similar spatial distribution, perhaps a local one. This suggestion is tempered somewhat by the occurrence in two Tusayan Whiteware sherds. The occurrence in two Mesa Verde Black-on-white sherds and a Navajo sherd is subject to speculation, but could again be the result of local availability to reduced later populations.

Igneous Rocks

San Juan Andesites and Diorites (Codes 301, 302, 341, 373, 701, 702, 773, 801, 802, 841, 873, 874).

"**Intermediate igneous, andesite, diorite, San Juan gravel.** White coarse-grained feldspar, light green pyroxene, and gold colored mica (3301 [=301 here] has black hornblende)."

"**Hornblende andesite Four Corners area.** White feldspar, black prisms of hornblende

Table 2.41. Type by vessel form for magnetitic sandstone temper.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed[a]	Total
Plain Gray	-	-	21	-	-	-	21
Lino Gray	1	-	10	-	1	26	38
Lino Fugitive	-	-	2	-	2	-	4
Obelisk Gray	1	-	13	-	-	3	17
Wide Neckbanded	-	-	3	-	-	-	3
Narrow Neckbanded	-	-	8	-	-	-	8
Neck Corrugated	-	-	8	-	-	-	8
PII Corrugated	-	-	13	-	-	-	13
PII-III + PIII	-	-	3	-	-	-	3
Unidentified Corrugated	-	-	21	-	-	-	21
Grayware	2	-	102	-	3	29	136
BMIII-PI Polished M/w	19	-	-	-	-	-	19
BMIII-PI Unpolished M/w	10	-	3	-	-	-	13
BMIII-PI Polished C/w	3	-	-	-	-	-	3
BMIII-PI Unpolished C/w	2	-	-	-	-	-	2
Red Mesa B/w	10	1	-	-	-	-	11
Escavada B/w	1	1	-	-	-	-	2
Gallup B/w	4	-	2	-	-	-	6
PII-III M/w	3	-	5	1	2	-	11
Exotic M/w	1	-	-	-	-	-	1
Tusayan White	2	-	-	-	-	-	2
Mesa Verde B/w	2	-	-	-	-	-	2
Unidentified White	7	-	-	-	-	-	7
Whiteware	64	2	10	1	2	-	79
Polished Smudged	10	-	-	-	-	-	10
Brownware	-	-	1	-	-	-	1
Navajo	1	-	-	-	-	-	1
Brown and Navajo wares	11	-	1	-	-	-	12
TOTAL	77	2	113	1	5	29	227
Percent	33.9	0.9	49.8	0.4	2.2	12.8	

[a] For this temper closed includes 28 tecomates and 1 Lino Gray canteen.
Not shown are 4 with unknown form and 1 Puerco Black-on-white effigy.
The Navajo bowl included here is not included elsewhere.

in a glassy groundmass; varying amounts of well rounded quartz" (Warren 1977:63).

Age: Quaternary gravels derived from laccolithic rocks in the San Juan mountains.

Distribution: Along major drainages from the San Juan, La Plata, and San Miguel Mountains in southwestern Colorado. These rivers include all northern tributaries to the San Juan River, including the Piedra, Florida, Los Pinos, Animas, La Plata, and Mancos Rivers, all of which had considerable Anasazi populations. Importantly, rocks of this composition are apparently rare south of the San Juan River.

In the early stages of the temper analysis, an effort was made to make the distinction shown above; but because of similarity of distribution and difficulty of confident discrimination, a somewhat different approach was adopted for the sites analyzed under System III (Table 2.23). In the latter approach, items were coded as to crushed andesite/diorite with (301, 701, 801) or without (302, 702, 802) visible hornblende, and rated as to the quantity of sand associated (700s—more quartz sand than rock; 800s—more rock than sand). "Well-rounded quartz" would have been unlikely to be differentiated from sand under this system. This temper is quite distinctive, appearing as angular fragments of white rock which often have darker splotches. Hornblende is usually evident as shiny black, rod-shaped, fibrous bars; pyroxene and mica are only occasionally visible.

Also included in this group is another class of crushed rock (probably an andesite) that occurs only rarely (seven cases recorded). It appears as shiny green to dark gray chunks of rock with occasional quartz. Warren (personal communication, 1979) identified one case as andesite/vitrophyre and suggested the Hovenweep area as a source. So few sherds were encountered with this kind of temper that there is little practical basis or necessity for distinguishing between gray glassy andesite and andesite vitrophyre.

Occurrence in the Chaco Sample. San Juan tempers are 3.5 percent of the total temper sample and occur primarily in whitewares and redwares (Table 2.24). They constitute over half of all the redwares in the sample. They are also important in early whitewares, typologically exotic whitewares and the latest whitewares (Tables 2.24 and 2.42). Of the 526 cases placed either by type or provenience, 19 percent are early whitewares, 19 percent are A.D. 920 to 1040 whitewares, and 17 percent are A.D. 920 to 1040 redwares. San Juan Redwares were the main redware in Chaco Canyon in the tenth century and much of the eleventh century, but numerically more cases of San Juan temper are found in whitewares than in redwares. Their presence in graywares is always a very small percentage. Among the sites, 29SJ 628 and 29SJ 633 stand out as having high percentages of San Juan temper (Table 2.24). Early, San Juan-tempered whitewares are especially abundant at 29SJ 628, while very late, whitewares are the main source at 29SJ 633.

While bowls are the most common form in the sample (around 43 percent), bowls form an inordinate proportion of the San Juan group (70 percent) with all other forms predictably low (Table 2.28). About two-thirds of the cases in this sample have medium or fine-grain sizes. The use of sherd temper is uncommon, with 74 percent having no association and 91 percent having less than half.

The subtypes of San Juan temper show some patterning (Tables 2.43 and 2.44). The most commonly recorded variety is unmixed with sand and contains hornblende. This type seems to be especially common in early mineral-on-white ceramics. The hornblende variety is much less common in sherds containing other materials (including sherd temper), while non-hornblende mixes are the second most abundant class. This may have to do with source selection through time, but is also likely to relate to the reduced likelihood of seeing hornblende when the rock portion is more finely ground and less abundant. When considering only the unmixed varieties, those containing hornblende are about twice as frequent as those lacking it. In terms of total occurrence (combining mixed and unmixed), the two are more evenly distributed. Given the reoccurring proportions of the varieties among wares and through time (allowing for an increase in the use of sherd temper), it is difficult to suggest a likelihood of source significance for the varieties as recorded. Variability in source seems especially likely if this temper came primarily from gravel outwash from the mountains.

Trachyte Temper (Codes 381, 781, 881).

"Navajo Volcanics, trachyte, trachybasalt, sanidine basalt, alkali feldspar trachyte. Fine, equiangular dark colored volcanic rock, with fresh, vitreous sanidine crystals, light green stubby diopside prisms and gold brown biotite" (Warren 1977:63; Mills et al. n.d.).

Age: Tertiary.

Distribution: There are two primary outcrops of this material, both in the Chuska Mountains: one at Beautiful Mountain and one at Washington Pass, though there are numerous volcanic outcrops in the Chuskas (Blagbrough 1967; Dane and Bachman 1965; Kelley 1967; Warren 1967). Trachyte cobbles are present on slopes and in washes on the eastern flanks of the mountains (Warren 1967).

This archeologically important rock has had a number of names. In addition to those shown above, it has been called "minette or its extrusive equivalent sanidine trachybasalt" (Blagbrough 1967:74), probable basalt and dark rock (Vivian and Mathews 1965), and melatrachyte (Loose 1977:567-568). It

Table 2.42. Type by vessel form for combined San Juan temper.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed[a]	Total
Plain Gray	-	-	3	-	-	-	3
Lino Gray	-	-	3	-	-	1	4
Lino Fugitive	-	-	2	-	-	-	2
Obelisk Gray	-	-	2	-	-	1	3
Wide Neckbanded	-	-	3	-	-	-	3
Narrow Neckbanded	-	-	6	-	-	-	6
Neck Corrugated	-	-	2	-	-	-	2
PII Corrugated	-	-	9	1	-	-	10
PII-III Corrugated	-	-	2	-	-	-	2
PIII Corrugated	-	-	5	-	-	-	5
Unident. Corrugated	-	-	11	-	-	-	11
Grayware	-	-	48	1	-	2	51
BMIII-PI Polished M/w	44	-	8	-	-	1	53
BMIII-PI Unpolished M/w	39	-	2	1	-	-	42
Early Red Mesa B/w	5	-	1	2	1	-	9
Red Mesa B/w	41	5	6	-	4	2	58
Escavada B/w	1	-	-	-	-	-	1
Puerco B/w	4	2	-	2	1	1	10
Gallup B/w	8	1	2	3	-	-	14
PII-III M/w	24	5	4	2	2	2	39
Exotic M/w	42	5	10	-	1	1	59
Mineral/white	208	18	33	10	9	7	285
BMIII-PI Polished C/w	8	1	-	-	-	-	9
BMIII-PI Unpolished C/w	8	-	-	-	-	-	8
Chaco McElmo B/w	1	-	-	-	-	-	1
PII-III C/w	15	1	3	-	1	1	21
Mesa Verde B/w	15	0	-	-	-	-	15
Carbon/white	47	2	3	-	1	1	54
Unidentified White	21	1	2	1	-	1	26
Polished Smudged	1	-	-	-	-	-	1
Plain Redware	5	-	5	-	-	-	10
Decorated Redware	143	4	20	2	-	7	176
Red and Brownwares	149	4	25	2	-	7	187
TOTAL	425	25	111	14	10	18	603
Percent	70.5	4.1	18.4	2.3	1.7	3.0	

[a] Closed forms for this temper are: 7 canteens, 5 seed jars, 6 tecomates.

Not shown are: 2 miniatures, 1 duck pot, 12 with unknown form (n = 618).

has been the practice in the present analysis to use trachyte (though we went through a trachybasalt phase) for two main reasons: 1) it is the shortest of all the above names; and 2) it seems to have the widest archeological currency (e.g., Franklin 1980, 1982; Garrett and Franklin 1983; Warren 1967; Zedeño et al. 1993). Mills et al. (1997) conclude that the most accurate term is alkali feldspar trachyte.

Trachyte is important archeologically for several reasons. It is readily recognized with a binocular microscope or, when not too finely ground, with the naked eye, and its geological distribution is very restricted. It is a heavily used temper source and it occurs in high frequencies in Chaco Canyon ceramics. It is distant enough from Chaco Canyon that it is unlikely to have been imported as a raw

Table 2.43. Occurrence of subtypes of San Juan temper by ceramic type.

Type	With Horn-blend	Horn-blend SS Mix	Without Horn-blend	No Horn-blend SS Mix	Gray Andesite	Total
Plain Gray	-	-	2	2	-	4
Lino Gray	3	-	-	-	1	4
Lino Fugitive	1	-	1	-	-	2
Obelisk Gray	2	-	1	-	-	3
Wide Neckbanded	1	1	-	1	-	3
Narrow Neckbanded	1	-	-	5	-	6
Neck Corrugated	-	1	-	1	-	2
PII Corrugated	3	1	3	4	-	11
PII-III Corrugated	-	-	1	1	-	2
PIII Corrugated	2	-	1	1	1	5
Unident. Corrugated	4	-	4	3	-	11
Grayware	17	3	13	18	2	53
BMIII-PI Polished M/w	33	5	6	8	1	53
BMIII-PI Unpolished M/w	32	3	5	2	-	42
Early Red Mesa B/w	-	2	1	6	-	9
Red Mesa B/w	6	11	4	35	2	58
Escavada B/w	-	-	-	1	-	1
Puerco B/w	-	3	2	5	-	10
Gallup B/w	2	2	1	9	-	14
PII-III M/w	8	7	7	19	-	41
Exotic M/w	19	9	8	22	1	59
Mineral/white	100	42	34	107	4	287
BMIII-PI Polished C/w	5	1	1	2	-	9
BMIII-PI Unpolished C/w	8	-	-	-	-	8
Chaco McElmo B/w	-	-	-	1	-	1
PII-III C/w	4	4	7	5	1	21
Mesa Verde B/w	2	4	5	4	-	15
Carbon/white	19	9	13	12	1	54
Unidentified White	14	6	7	5	-	32
Polished Smudged	-	-	1	-	-	1
Plain Redware	7	-	2	2	-	11
Decorated Redware	91	26	46	17	-	180
Red and Brownwares	98	26	49	19	-	192
TOTAL	248	86	116	161	7	618
Percent	40.1	13.9	18.8	26.1	1.1	

material for pottery-making and therefore probably represents ceramic import to the canyon.

There is some debate as to the precise source of the trachyte used prehistorically for temper. Warren (1967) concluded that the specimens from Beautiful Mountain were the most similar to the temper, but Garrett notes that the texture of the sanidine in sherds is dissimilar to samples from Sanostee Wash, which drains Beautiful Mountain (Garrett and Franklin 1983:312-313). Significantly, Garrett notes that the rock in her sample of sherds (n=24) was very homogeneous, suggesting a limited, but as yet unknown source. The sample includes sherds from the Chuska Valley and from Pueblo Alto. Zedeño et al. (1993:206) also report a lack of similarity between trachyte in sherds from the vicinity of Indian Creek (in between Chaco Canyon and the Chuska Mountains) and raw trachyte from Washington Pass. They conclude that the rock used was fresh rather than weathered. Mills et al. (1997) have reviewed a number of sources and conducted firing tests and argue convincingly that Narbona Pass (formerly Washington Pass) is the most likely source of the temper. Shepard (1939:280-281), once again precocious, came to the same conclusion.

Table 2.44. San Juan temper subtypes by form and site.

Form	With Hornblend	Hornblend SS Mix	Without Hornblend	No Horn-blend SS Mix	Gray Andesite	Total
Form						
White bowl	115	36	38	84	4	277
Ladle	3	2	4	15	-	24
Pitcher	1	3	2	6	-	13
Olla	-	5	-	5	-	10
Canteen	2	1	3	1	-	7
Seed Jar	3	1	-	1	-	5
Tecomate	-	1	-	-	1	2
White jar	11	8	6	13	-	38
Gray jar	15	3	13	15	2	48
Other gray	2	-	1	-	-	3
Red bowl	75	23	35	14	-	147
Red jar	14	1	9	1	-	25
Other red	2	-	2	-	-	4
TOTAL	243	84	113	155	7	603
Site						
29SJ 423	2	-	1	1	-	4
29SJ 299-BMIII	1	1	9	5	1	17
29SJ 628	73	6	1	-	-	80
29SJ 721	-	-	1	-	-	1
29SJ 299-PI	6	-	1	-	-	7
29SJ 724	23	2	1	-	-	26
29SJ 629	20	4	19	10	3	56
29SJ 1360	7	5	19	71	1	103
29SJ 627	78	46	33	33	1	191
Pueblo Alto	32	17	22	25	1	97
29SJ 633	6	5	13	12	-	36
TOTAL	248	86	120	157	7	618

There are, of course, other igneous sources in the predominantly sedimentary San Juan Basin, some of which are technically trachyte. Mount Taylor is a prominent candidate and archeologists from the School of American Research reported finding "trachyte" in that area (Cerro Aliso Quadrangle, J. Beal, personal communication, 1984). Warren (1967:112) concludes that the trachyte described from Mount Taylor is different from that of the Chuskas, but there is clearly room for more detailed work. Mount Powell overlooks the Red Mesa Valley and is a small, very isolated basaltic outcrop (Dane and Bachman 1965; O'Sullivan and Beaumont 1957). I know of no technical studies of this basalt, but hand specimens of the material have different colored constituents from those in trachyte-tempered sherds and could, in most cases, be distinguished from trachyte.

While the geological source of trachyte is remarkably well-localized, it is not the only source of trachyte in pottery. The use of sherd temper in Chaco-Cibola Whitewares was well established in the A.D. 900s. With the movement of large quantities of Chuskan pottery, especially to Chaco Canyon, the possibility of using trachyte-tempered potsherds for temper (whether purposely or randomly selected) increased through time at locations outside the Chuska Valley. The quantity and form of trachyte and the materials associated with it thus are relevant information in estimating the likelihood that a given sherd came from a vessel made in the Chuskas or from one made elsewhere. To that end, observations of trachyte mixed with quartz (Code 881) were made throughout the analysis. It became evident, however, that even this differentiation was not enough and for the sites analyzed later (System IIIa, see above), sherds having more-sandstone-than-trachyte (Code 781) were distinguished from those estimated as having more-trachyte-than-sandstone (Code 881). For the sites where this distinction was made, vessels having more-sandstone-than-trachyte were conservatively considered to be non-imports (see Import Section). At sites where the distinction was not made, all mixed trachyte-sand items were necessarily considered as likely imports. For most sites, this lack of differentiation is unlikely to be a serious problem because most are early sites, and trachyte, especially in a mixed form, is not abundant. At 29SJ 627, there is potentially a greater problem which is magnified by the fact that 29SJ 627 has the largest site collection. Thus, trachyte figures are inflated to some degree by this problem at 29SJ 627. That inflation is countered to some other degree by the fact that some of the more-sandstone-than-trachyte sherds are probably Chuskan (Toll and McKenna 1987).

In the tables included here (Tables 2.45-2.48), all trachyte mixes are treated together to bring comparability of treatment to all sites. Breakdowns of type and form by differentiated mixes are also presented for the group of sites for which the information is available (Tables 2.45 and 2.46). A note is necessary on the precision of the estimates of constituents. The thin-section analysis conducted by Gary Chandler included a number of sherds which we selected because they had been coded for trachyte content by our analysis. In their far more precise point counts, the ratios of trachyte to sand in many cases are either close or favor the sand, while they were recorded in our system as having more trachyte. It is probably more accurate, then, to consider our "more-trachyte-than-sand" as meaning "enough trachyte that there is a reasonable chance that it was added separately," while "more-sand-than-trachyte" cases have much smaller, more finely-ground trachyte that is more likely to have been introduced from sherd temper. If the only trachyte we saw in a sherd was visibly still in sherd temper, that sherd was not recorded as being trachyte-tempered. Chandler's study recorded a number of cases as having trachyte-tempered sherd temper, and I infer that his point counts include that trachyte as well. There are six cases where Chandler records some trachyte, but our code reflects none. In four of these cases, he records trachyte in sherd temper and in the other two the trachyte is recorded as 1 percent and 4 percent of the total temper.

Garrett (1985) included five Gallup Black-on-white sherds from Chaco sites for comparison to a series from the Prewitt area. Three of these contain sherd temper with trachyte and all contain sand grains. None of the 35 sherds from the Red Mesa Valley sites in her thin-section analysis contained any trachyte temper. She specifies the tempering material to be Chuska Whiteware, but does not discuss why it could not be grayware. She assumes that vessels with trachyte-tempered sherd temper were made in Chaco Canyon and notes that Chuska Whitewares would have been depleted through use as temper (Garrett 1985:184). Percentages of Chuska Whiteware in the Chaco Project samples are indeed small (Table 2.25). If Chuskan Whitewares were imported in the same frequencies as graywares, severe depletion clearly did take place. Since such thorough removal from the record may be questioned, there are alternatives to this explanation:

1) Graywares may have been used as tempering materials. Given known distributions and assuming random selection of sherds for tempering in Chaco favors this alternative. It is unlikely, however, that selection of sherds for temper was random, especially for fine-textured whitewares.

2) Sherds containing trachyte could have been used as a temper in the Chuska area where known distributions suggest that Chuska Whitewares were much more abundant than in Chaco. The ENRON or Transwestern Pipeline Project ceramic analysis assumed that any sherd containing trachyte was a Chuska product, and found support for that practice in the compositional analyses performed (Zedeño et al. 1993:188, 226-227). This finding supports our contention that these import estimates are conservative. Although relevant to interpretation of the Chaco Project counts, it is not directly applicable. Since the ENRON sites are 35 km closer to the source of trachyte and trachyte-tempered pottery, the likelihood that any sherd containing trachyte is in fact "Chuskan" is greater than at Chaco. Without further detailed compositional analysis of sherds from this temper category from Chaco, proportions of sand and trachyte vessels produced in the Chuska Valley versus those produced closer to or in Chaco Canyon cannot

Table 2.45. *Type distributions for three classes of trachyte temper from sites 29SJ 423, 29SJ 299-BMIII, 29SJ 629, 29SJ 1360, and Pueblo Alto, where the three were distinguished.*

Type	Unmixed Trachyte	Sandstone > Trachyte	Trachyte > Sandstone	Total
Plain Gray	33	1	1	35
Lino Gray	4	1	2	7
Wide Neckbanded	11	-	-	11
Narrow Neckbanded	56	2	3	61
Neck Corrugated	25	1	3	29
PII Corrugated	145	2	18	165
PIII-III Corrugated	56	2	8	66
PIII Corrugated	12	1	4	17
Unidentified Corrugated	422	-	56	478
Grayware	764	10	95	869
BMIII-PI Polished M/w	10	1	-	11
BMIII-PI Unpolished M/w	4	-	-	4
Early Red Mesa B/w	1	6	3	10
Red Mesa B/w	6	23	23	52
Escavada B/w	-	3	1	4
Puerco B/w	3	20	3	26
Gallup B/w	35	129	107	271
Chaco B/w	-	12	4	16
PII-III M/w	14	47	30	91
Exotic M/w	17	9	11	37
Mineral-on-white	90	250	182	522
BMIII-PI Polished C/w	27	-	6	33
BMIII-PI Unpolished C/w	1	-	1	2
Chaco McElmo B/w	2	22	19	43
Tusayan Whiteware	-	1	-	1
PII-III C/w	4	11	19	34
Mesa Verde B/w	1	-	3	4
Carbon-on-white	35	34	48	117
Chuskan w/Red Mesa	43	1	12	56
Chuska B/w	42	1	20	63
Chuskan Whiteware	83	11	35	129
Chuskan White	168	13	67	248
Unidentified White	12	9	14	35
Plain Red	1	-	-	1
Decorated Red	8	-	-	8
Redware	9	-	-	9
TOTAL	1,078	316	406	1,800
Percent	59.9	17.6	22.6	

be determined. Controlling for relative quantities of trachyte in sherds remains a way of estimating likelihood, however crude.

Occurrence in the Chaco Sample. As divided in Table 2.24, the two classes of trachyte-containing temper are the third and fourth most common tempers in the sample. Even allowing for the fact that some of the trachyte-sandstone mix cases were probably not made in the Chuskas, the abundance of trachyte shows clearly what an important source the Chuskas were. Moreover, given the dramatic increase in trachyte occurrence in the A.D. 1040 to 1150 time span, trachyte was an even more important temper than the totals in Table 2.24 indicate.

Table 2.46. Form and site distributions for three classes of trachyte temper from sites 29SJ 423, 29SJ 299-BMIII, 29SJ 629, 29SJ 1360, and Pueblo Alto, where the three were distinguished.

	Unmixed Trachyte	Sandstone > Trachyte	Trachyte > Sandstone	Total
Form				
White bowl	183	174	165	522
Ladle	33	18	26	77
Pitcher	16	23	20	59
Olla	5	13	15	33
Canteen	1	2	2	5
Gourd jar	3	1	3	7
Seed jar	-	3	3	6
Tecomate	3	1	1	5
White jar	62	68	70	200
Effigy	-	-	1	1
Duck Pot	1	-	-	1
Cylinder jar	-	-	1	1
Grayware jar	751	10	94	855
Grayware pitcher	3	-	1	4
Red bowl	7	-	-	7
Red jar	1	-	-	1
Miniature	-	2	4	6
TOTAL	1,069	315	406	1,790
Site				
29SJ 299-BMIII	17	-	2	19
29SJ 423	1	-	-	1
29SJ 629	123	20	27	170
29SJ 1360	120	22	41	183
Pueblo Alto	817	274	336	1,427
TOTAL	1,078	316	406	1,800

Trachyte temper, unmixed with sand is the class most clearly from the Chuska area and it forms a class distinctive from the mixed-temper class (Tables 2.47 and 2.48). There is an overwhelming association of this temper with grayware jars, especially corrugated ones. In Pueblo II Corrugated, Pueblo II-III Corrugated, and unidentified corrugated ceramics, around half of all cases are trachyte. The other class in which trachyte is dominant in Chaco Canyon ceramics is carbon-painted whitewares, but the numbers in that class are far less than in the graywares. Significant numbers of mineral-painted whitewares also have unmixed trachyte temper, but trachyte constitutes only a small percent of that very large class.

The trachyte-sandstone mix cases are almost opposite of the pure trachyte distributions. The mixed group is by far the most abundant in the mineral-on-white groups, followed by carbon-on-white and then graywares (Table 2.48). The mixed temper group contains a carbon-painted ware percentage similar to that of the unmixed group (much higher than the norm) and a few low relative frequency of graywares. While the mixed group is, therefore, very low in overall percentage of grayware jars, it contains substantially higher frequencies of both whiteware pitchers and jars. Both mixed and unmixed trachyte occur most often in Gallup Black-on-white, but the Chuska carbon series solid designs (Chuskan Red Mesa and Chuska Whiteware in the tables) are more abundant than hachure (Chuska Black-on-white).

A better idea of the composition of the mixed group can be gained from Tables 2.45 and 2.46, which show the breakdown of trachyte types for sites at which unmixed, more-sandstone-than-trachyte and

Table 2.47. Type by vessel form for unmixed trachyte temper.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed[a]	Total
Plain Gray	-	1	52	-	-	-	53
Lino Gray	-	-	6	-	-	-	6
Obelisk Gray	-	-	2	-	-	-	2
Wide Neckbanded	-	-	28	-	-	-	28
Narrow Neckbanded	-	-	122	-	-	-	122
Neck Corrugated	-	-	57	-	-	-	57
PII Corrugated	-	-	338	2	-	-	340
PII-III Corrugated	-	-	94	-	-	-	94
PIII Corrugated	-	-	23	-	-	-	23
Unident. Corrugated	-	-	456	1	-	-	457
Grayware	-	1	1,178	3	-	-	1,182
BMIII-PI Polished M/w	16	1	-	1	-	1	19
BMIII-PI Unpolished M/w	3	-	3	1	1	-	8
Early Red Mesa B/w	1	1	-	-	-	-	2
Red Mesa B/w	20	5	-	-	1	2	28
Escavada B/w	1	-	-	-	-	-	1
Puerco B/w	3	5	-	1	-	1	10
Gallup B/w	34	4	21	8	1	3	71
PII-III M/w	20	8	10	2	1	-	41
Exotic M/w	19	4	4	1	-	-	28
Mineral/white	117	28	38	14	4	7	208
Percent	56.3	13.5	18.3	6.7	1.9	3.4	
BMIII-PI Polished C/w	19	2	14	4	-	1	40
BMIII-PI Unpolished C/w	-	-	3	-	-	-	3
Chaco McElmo	1	-	-	1	-	-	2
PII-III C/w	12	3	6	1	-	-	22
Tusayan White	2	-	-	-	-	-	2
Mesa Verde B/w	1	1	-	-	-	-	2
Carbon/white	35	6	23	6	-	1	71
Percent	49.3	8.5	32.4	8.5	-	1.4	
Chuska Red Mesa	47	13	14	9	1	1	85
Chuska B/w	45	7	10	2	2	1	67
Chuska White	83	33	13	9	5	2	145
Chuska Whiteware	175	53	37	20	8	4	297
Percent	58.9	17.8	12.5	6.7	2.7	1.3	
Unidentified White	13	3	18	3	3	1	41
Plain Redware	6	-	-	-	-	-	6
Decorated Redware	23	-	2	1	-	1	27
Polished Smudged	1	-	-	-	-	-	1
Red and Brownwares	30	-	2	1	-	1	34
TOTAL	370	91	1,296	47	15	14	1,833
Percent	20.2	5.0	70.7	2.6	0.8	0.8	

[a] Closed for this temper includes 3 gourd jars, 5 tecomates, 2 seed jars, and 4 canteens.

Not shown are 1 effigy, 2 duck pots, 2 mugs, 1 pipe, 1 miniature, and 36 with unknown form (N = 1,876).

more-trachyte-than-sandstone were distinguished. It is evident that mixed tempers in Chuskan and graywares are likely to be predominantly trachyte, while in mineral-painted vessels (except for exotic mineral-on-white), sandstone predominance is more likely, especially in later types (see also the Pueblo

Table 2.48. Type by vessel form for all mixed trachyte-sandstone temper.

Type	Bowl	Ladle	Jar	Pitcher	Olla	Closed[a]	Total
Plain Gray	-	-	3	1	-	-	4
Lino Gray	-	-	4	-	-	-	4
Narrow Neckbanded	-	-	12	-	-	-	12
Neck Corrugated	-	-	5	-	-	-	5
PII Corrugated	-	-	34	-	-	-	34
PII-III Corrugated	-	-	14	-	-	-	14
PIII Corrugated	-	-	8	-	-	-	8
Unident. Corrugated	-	-	65	-	-	-	65
Grayware	-	-	145	1	-	-	146
BMIII-PI Polished M/w	5	-	2	-	-	-	7
BMIII-PI Unpolished M/w	-	-	1	-	-	-	1
Early Red Mesa	12	1	1	1	-	-	15
Red Mesa B/w	110	12	16	4	1	4	147
Escavada B/w	3	1	-	1	-	-	5
Puerco B/w	17	5	7	1	1	1	32
Gallup B/w	175	23	83	26	5	9	321
Chaco B/w	3	-	12	8	-	-	23
PII-III M/w	62	19	22	9	21	10	143
Exotic M/w	17	2	6	1	-	2	28
Mineral/white	404	63	150	51	28	26	722
Percent	56.0	8.7	20.8	7.1	3.9	3.6	
BMIII-PI Polished C/w	2	-	4	2	-	-	8
BMIII-PI Unpolished C/w	1	-	-	-	-	-	1
Chaco McElmo B/w	31	2	3	6	-	-	42
PII-III C/w	38	3	6	2	2	-	51
Tusayan White	1	-	-	-	-	-	1
Mesa Verde B/w	3	1	-	-	2	-	6
Carbon/white	76	6	13	10	4	-	109
Percent	69.7	5.5	11.9	9.2	3.7	-	
Chuska Red Mesa	13	4	5	5	-	-	27
Chuska B/w	14	2	5	1	1	-	23
Chuska White	36	6	9	2	7	-	60
Chuska Whiteware	63	12	19	8	8	-	110
Percent		10.9	17.3	7.3	7.3	-	
Unidentified White	19	6	13	1	5	-	44
Decorated Redware	2	-	-	-	-	-	2
TOTAL	564	87	340	71	45	26	1,133
Percent	49.8	7.7	30.0	6.3	4.0	2.3	

[a] Closed for this temper includes 4 canteens, 13 seed jars, 4 tecomates, 4 gourd jars, and 1 cylinder jar.
Not shown are: 12 with unknown form, 7 miniatures, 1 effigy, and 1 duck pot (n = 1,154).

Alto distribution in Table 2.24). Carbon-painted Chaco McElmo Black-on-white is in between its mineral-painted Cibola counterparts and other carbon-painted wares in being evenly split. At least some of the carbon types would have been types in the Chuska Whiteware series, had that dichotomy been in effect. There seems to be a consistent trend of more trachyte in larger closed forms (ollas and whiteware jars) and in ladles. These distributions support the conclusion reached elsewhere (e.g., Toll and McKenna 1987) that at least some of the cases rated as having more-sandstone-than-trachyte were likely to have been made in the Chuska area. Garrett and Franklin (1983:312) report an individual case of a trachyte-tempered sherd containing sand-tempered sherd temper from the Chuska area, which illustrates that temper mixtures exist from various sources and in various combinations and that sand-trachyte mixes are quite possible from the Chuska Valley.

Trachyte is absent from the earliest ceramics in the Chaco Project assemblage, first appearing in the A.D. 700s (Figure 2.9). It is evenly spread among wares in the A.D. 700s and 800s and is not present in large quantities in terms of absolute numbers. As a percentage of the total dated assemblage, trachyte increases steadily through the last time group. Carbon-painted trachyte-tempered whitewares are a more or less steady component of the assemblage until after A.D. 1100 when they nearly equal the Chuskan graywares. The rare, early Chuskan Redwares were missing from assemblages after A.D. 1040, and were probably only produced before A.D. 900.

Minor Tempers: Tusayan, Socorro and Unidentified Igneous (Codes 245, 390 and 300). These tempers are relatively rare or have ambiguous meaning. Tusayan temper was not recorded specifically during the analysis, but was automatically assigned to sherds with sandstone temper, which were typologically identified as Tusayan Whiteware. While this practice is clearly less than rigorous, it does have an empirical basis. Typologically identified, Tusayan sherds found in Chaco tend to have abundant medium-to-coarse, white-to-clear, clean sand temper, with little use of sherd temper. There is undoubtedly variability in Tusayan Whiteware tempers (Garrett 1980), which goes unrecognized here, but this approach segregates this surely nonlocal group in the temper analysis.

"Socorro temper" (a mnemonic, if unfortunate, conflation of a type name with a temper) does refer to a particular igneous temper. Under the dissecting microscope, it appears as small black specks of crushed rock as well as some clear fragments. Warren identifies this substance as hornblende latite. Sundt (1979) includes this temper in his type description of Socorro Black-on-white, but there was an effort to use the temper and the type independently in this analysis.

"Unidentified igneous" could, of course, be anything; but it is most likely to be San Juan igneous, on the grounds that the most common igneous temper—trachyte—is less likely to be subject to ambivalent identification. The majority of the white, gray, and redwares seen in Table 2.49 are, thus, probably San Juan, trachyte and possibly Socorro, in that order. Alternatively, the polished smudged bowls, which form 10 percent of the temper, are likely to be some other material of igneous origin.

Other Paste Variables

As noted in the discussion of the earlier temper recordings systems, a variety of paste attributes were monitored (under Sandstone Temper above). Many of these were rarely observed, particularly in finer, later pastes, and they were abandoned for more generally applicable attributes, which were recorded for the majority of the detailed analysis sherds. Definitions of the attribute states of these variables and their co-occurrence with major temper types follow.

Temper Grain Size

Because of the concern with sandstone grain size, this variable records the grain size of sand, if any is present. Although useful for the detection of possibly nonlocal tempers (see Sandstone Section above), this practice does detract from the relationship of this variable to paste texture. The size ranges recorded are as follows: 1) very fine to fine, less than 0.25 mm; 3) medium, 0.25 to 0.75 mm; 5) coarse, 0.75 to 1.25 mm; and 6) very coarse, larger than 1.25 mm. All were measured relative to the eye of a needle, which was 1 mm wide with an opening of 0.5 mm. Unfortunately, grain size frequently covers a range of diameters crossing the above-coding boundaries. In such cases, an effort was made to characterize the grain size rather than to select the largest. This attribute was recorded for all sherds in the analysis, but in greater detail (smaller size ranges) for the System I and II sites (see Table 2.32).

Temper Density

The amount of visible temper varies tremendously among sherds and this variable is an attempt to place sherds ordinally according to quantity of temper. Bennett (1974) advocates a much more involved recording of the density of each temper element, but that approach seemed impossibly time-consuming. We compared the visible temper

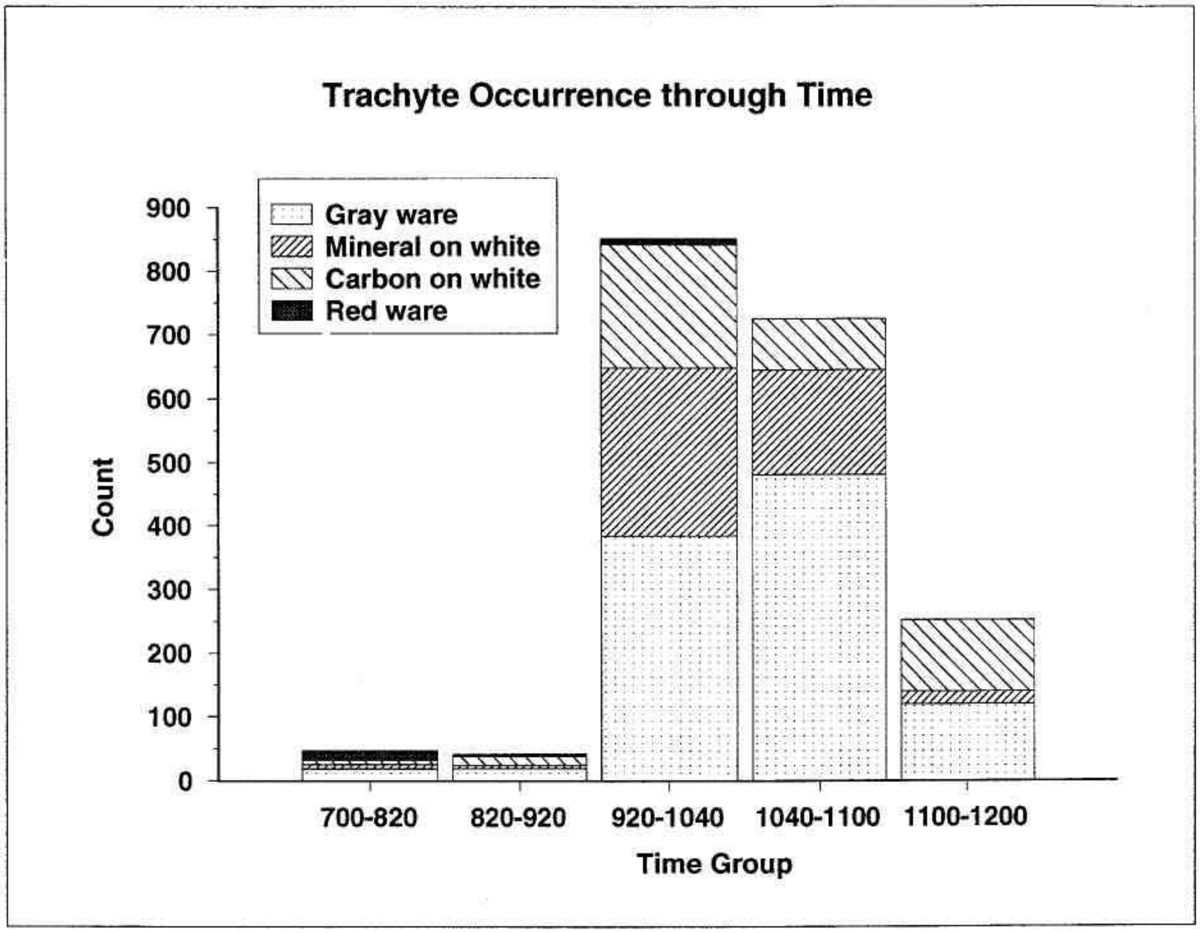


Figure 2.9A. *Occurrence of trachyte through time. A) Counts of trachyte temper by time group showing ware breakdowns. Only specimens falling in time groups of 120 years or less are shown. Samples sizes:*

A.D. 700 to 820	*48*
A.D. 820 to 920	*41*
A.D. 920 to 1020	*851*
A.D. 1020 to 1120	*754*
A.D. 1120 to 1220	*251*

density to Bennett's (1974:105) templates and recorded the following estimated densities: 1) 1 to 2 percent; 2) 5 percent; 3) 10 percent; 4) 20 percent; 5) 30 percent; and 6) 40 percent or more. This attribute was recorded for all sites analyzed under System III, except for a few 29SJ 627 sherds.

Paste Groups

This variable allowed for monitoring the occurrence of specific colors and combinations of sherd temper and paste color. Because many sherds do not conform to any of the paste types defined,

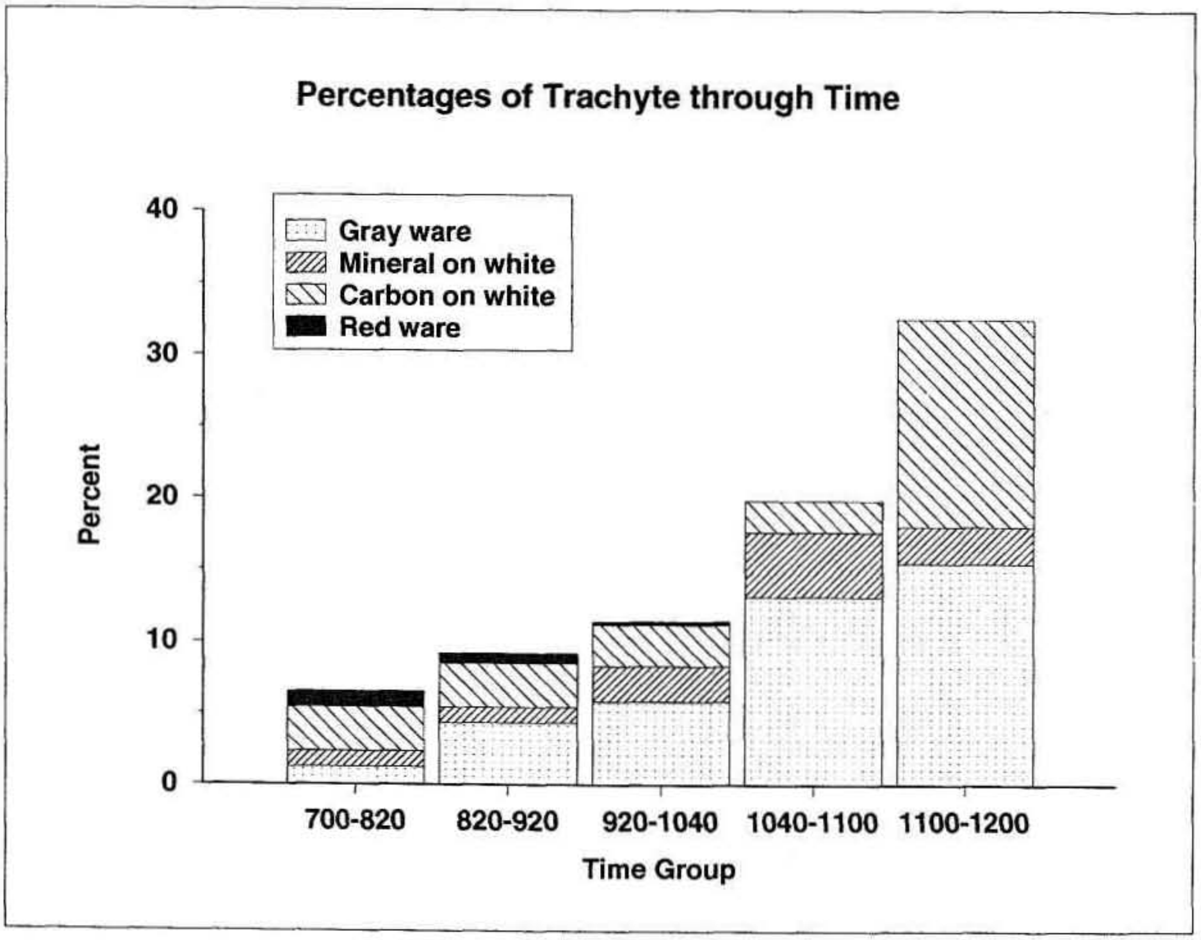


Figure 2.9B. Occurrence of trachyte shown as percent of total time groups.

there is a large number of items for which "no paste type" was recorded. In retrospect, a more comprehensive means of recording paste color would have been to continue the practice established for System II in which Munsell color groups were defined and recorded. The latter is subject to some practical problems; that is, a significant number of sherds have variable core colors. The paste combinations included in this system are:

Type 1. Black clay with white sherd fragments, with the sherd often being abundant. Sherds with this paste usually have surfaces much lighter than their cores, with the surfaces appearing in cross-section as thin rinds. The black paste here does not look like a carbon streak, but may well be of similar origin. Warren (personal communication, 1977) was of the opinion that black pastes (Type 8) tended to associate with Chinle Formation tempers and were, therefore, from south of Chaco Canyon. This, of course, needs further study.

Type 2. Gray clay with predominantly black sherd fragments. In some cases, this appearance

Table 2.49. Occurrence of minor tempers by vessel form.

Form	Tusayan Sandstone	Socorro (Igneous)	Unident. Igneous
Whiteware bowl	65	9	116
Ladle	1	-	26
Canteen	1	-	3
Pitcher	-	-	8
Seed jar	1	-	2
Gourd jar	-	1	1
Olla	-	-	4
Tecomate	-	-	1
Whiteware jar	-	1	19
Grayware jar	-	-	6
Redware bowl	-	-	4
Redware jar	-	-	1
Smudged bowl	-	-	21
Miniature	-	-	3
TOTAL	68	11	217

probably results from vitrification of the sherd temper (that is, sherd temper with a lower vitrification point than that of the body clay), while in others, it probably results from use of sherds with black paste for temper. Sometimes the black particles can be seen to have melted and bubbled.

Type 3. Black and white sherd temper in a gray paste. This code was instituted after the 29SJ 627 analysis and was used with less frequency.

Type 4. "Little Colorado Paste." Based on comparison with and descriptions of pottery from east central Arizona, a distinctive paste with dark gray body and abundant "white angular fragments" (mainly sherd, but possibly also some crushed rock), this code was established primarily to identify possible imports, but also to serve as an identification for the rare sherds that are typologically recognizable as coming from the Little Colorado region (provided, of course, that they indeed had "Little Colorado Paste"). This is by far the least often used paste type.

Type 5. "Chuska gray" paste. Many sherds from the Chuska Valley, both white and grayware, have homogeneous gray paste with a distinctive cast to them, which might be called slightly greenish (more or less Munsell 5Y 5/1-6/1—Windes 1977: 299). It must be noted that the presence of trachyte affects the appearance of a paste and that it contributes to the use of this code. Not all trachyte-tempered sherds have this paste and it is a potential means of defining variability within the trachyte group.

Type 6. Gray paste with white sherd temper. Usually, the body clay here is lighter than what would be expected for Little Colorado paste and the sherd temper is finer. This is a fairly broad paste category and a very large one in Chaco.

The following three codes were used for all System III sherds except the 29SJ 627 whitewares:

Type 7. Brown to tan body clay. This code is based strictly on color, but sherds falling into this category rarely or never had carbon streaks. The code was initiated because there seems to be a consistent group of tan sherds in early utility wares.

Type 8. Black paste, regardless of sherd temper. This type is more likely in graywares because of the infrequency of sherd temper in graywares and a substantial number of whitewares with sherd temper will fall into Type 1.

Type 9. White paste. This code was used only for sherds almost completely lacking color.

Sherd Temper

Sherd tempering of pottery found in Chaco Canyon became extremely common in the tenth century (see Sandstone Section above; Figures 2.2 A, B, C). An estimate of the quantity of sherd temper, relative to other temper, was made throughout the analysis. The categories possible were: 0) sherd temper absent; 1) less than half sherd temper; 2) more than half sherd temper; 3) nearly all sherd temper (more than 95 percent); and 9) estimate not possible. With a binocular microscope, there are doubtless many cases in which it is difficult to see or positively identify sherd temper, but in most cases the broad estimate outlines can be approximated.

Texture Index

The texture index was devised not only to try to combine the effects of temper grain size and quantity, but also to determine quantity of sherd temper. We observed that sherd temper seems to contribute less to coarseness and friability of paste than do geologic tempers, especially sand grains. The index was calculated by multiplying the ordinal grain size estimate for the geological temper by the density estimate code and then dividing by the relative quantity of sherd temper. The drawbacks to this index include that the grain size is for sand (if it is present), no matter what its quantity, and that it involves the multiplication of ordinal variables. It does, however, provide an ordinal measure of paste texture that is based on empirical observation of ceramics.

$$\textit{texture index}=\frac{\textit{grain size}\,[\textit{values } 1,3,5,6] * \textit{temper density}[1\text{-}5]}{(\textit{sherd temper } [0,1,2,3]) +1}$$

Vitrification

This variable is again a visual estimate of position on a continuum. If the paste seen in a fresh break had a sheen and, less importantly, if the sherd was hard and brittle, it was considered vitrified. Initially, in Systems I and IIIa, this was recorded on a presence/absence basis. In a few cases in System I (Site 29SJ 724), inclusions not related to vitrification were recorded with this variable; in System II, vitrification was unwisely recorded as a clay color state. Vitrification was reinstituted as an independent variable in System IIIa, but as more sherds were examined (especially later ones), it became clear that some sherds were quite definitely vitrified, while others had shiny paste but seemed less glassy. For System IIIb, then, an intermediate, more commonly used category of vitrification present was added to marked vitrification: 0) vitrification absent; 7) vitrification present; and 8) vitrification marked (System IIIb) or vitrification present (System II, IIIa). The intermediate code (7) might more correctly be thought of as "sintered" or well-fired: most such cases probably involve well-fused clay minerals which have not yet turned to glass, although, again, the determination was entirely a visual judgement. Sherds with black mineral paints, especially those that look "glazey," have well-vitrified pastes more often than sherds with green, red, or brown mineral paint or those with carbon paint (Table 2.8). Among painted sherds, those with reddish mineral paint have the highest percentage of sherds appearing to lack any stage of vitrification.

Clay Studies

To add dimension to refiring studies and to investigate the availability of resources for ceramic manufacture, several clay samples were collected from around Chaco Canyon. These samples were processed according to a scheme worked out with Hayward Franklin, who was doing similar sampling in the Bis sa'ani and Navajo Mine areas (Franklin 1982; Garrett and Franklin 1983). Detailed sample-by-sample descriptions are available on the clay sample forms found in Appendix 2C. This clay sampling project was of the "spare time" variety, and some of the results are incomplete and coverage of the canyon is spotty and scant. The number of geological clay exposures in and around central Chaco Canyon is immense; therefore, complete systematic coverage of the whole area would be a large project unto itself (see Rye 1981:12-13; Shepard 1956:148-156). Combined with other clay sampling projects (such as Bubemyre and Mills 1993; Franklin 1979, 1982:924; Garrett and Franklin 1983:314-319; Lucius and Wilson 1981; Wills in Warren 1976; Windes 1977), these samples are indicative of the complexity of firing colors of available clays and the trends of clay color occurrence. Portions of unprocessed clay samples and the firing tiles are housed at the University of New Mexico with the Chaco Project materials.

Procedures

A sample of several kilograms of clay was taken in the field and located on a quad map. Usually, these samples were from locations which could be tied to specific geological formations, but a few came from alluvial situations. All of the in situ samples are sedimentary Cretaceous clays and all the secondary alluvial clays were probably derived from Tertiary and Cretaceous deposits. A portion of each sample was then soaked in tap water for at least 24 hours, though some were left soaking for considerably longer. None of the samples we collected required grinding, but some broke down in water considerably more slowly than others. The samples were generally quite free of either organic or mineral contamination and none of them were screened. Some samples contained non-clay materials such as fragments of sandstone or concretions and these were removed when working the samples by hand. As a part of the soaking process, a small quantity of each sample was mixed with enough water to put all the clay into suspension, which was then allowed to settle. The rate of settling and the visual composition of the column was then recorded. Following the soaking period, the samples were allowed to dry sufficiently to be workable, at which time simple workability tests were performed; for example, forming and knotting fillets, pinching a small pot, and repeatedly forming and flattening a ball (Rye 1981:12-13). Two tiles were then formed. Ideally, each tile would be 5-by-10 cm and 1 cm thick, but hand forming meant that the tiles varied within a centimeter around that standard. Each tile was marked with its clay sample number. When the tiles were formed and marked, the length and the width were measured with sliding calipers to the nearest hundredth of a centimeter, leaving marks in the tile so that the same dimension could be measured in subsequent states; Munsell colors were recorded for the wet stage. The tiles were then allowed to air dry at room temperature. As the tiles were placed on a solid surface they were occasionally turned during the drying period. When the tiles were leather hard, an area on the "a" tile was polished with a pebble. After the tiles were completely dry, they were measured again to allow calculation of shrinkage and the Munsell color was again recorded. Notes were kept on the workability and drying characteristics of each sample (Appendix 2C).

Most refiring of prehistoric ceramics is conducted at 900° C; the majority of the present samples were fired in an electric kiln at 910° C (a few were fired at 950° C). Measurements and Munsell colors were again recorded along with observation of fired qualities. Most of the samples were also subjected to a firing at 1250° C in order to observe the effects of extreme (for aboriginal firing) temperatures.

Results

Menefee Formation. The most widely exposed formation in the Chaco Canyon area is the Menefee and 14 of the 21 Chaco samples reported here came from Menefee outcrops (Table 2.50). The Menefee Formation is visible in Chaco Canyon itself just below the sandstone cliffs of the Cliff House Formation and in the rolling country south of the canyon (Dane and Bachman 1965). Most (10 of 14) of the Menefee Formation samples worked well, dried with minimal cracking, and fired well. The eight samples that were rated "good" and dried and fired without cracks shrank an average of 11.2 percent (s.d.=2.2 percent) in length. This seems a substantial amount, but it should be remembered that the tiles were untempered. The greatest amount of shrinkage was in a tile that did not crack (No. 11), and the overall shrinkage in length for Menefee Formation samples was 10.9 percent (s.d.=2.1 percent). The Menefee samples, which were sticky, difficult to work, and exhibited major drying cracks, were from weathered Menefee deposits, while the rest were from hard strata protected from the weather. Sample No. 8 and especially Sample No. 4 contained materials that did not dissolve, which hampered their workability; grinding and sieving would presumably have helped these samples.

Cliff House Formation. Clay appears to be less abundant in Chaco Canyon's Cliff House Formation, but pockets may be found along the benches above the first cliff in the central canyon. Only three Cliff House samples are included here. All were workable, but only one seemed to be problem free. Drying shrinkage was generally less in these samples than in the Menefee samples, though two of the three fall within the Menefee range.

Lewis Shale. A single, sandy sample of clay material from beneath Plaza 2 at Pueblo Alto. The

Table 2.50. Summary of colors and qualities of clays tested. Except for the control samples, all samples are from the Chaco vicinity.

FORMATION/ Sample Number, Location	Dry Color	910°C Color	Windes' Group	Qualities				1250°C Color	1250° Alterations
				Work.	Crack.	Shrinkage %			
						Width	Length		
MENEFEE FORMATION									
#1 Fajada Butte	10/YR 6/2	7.5YR 7/4	2	Good	None	9.3 x	10.8	10YR 5/2	6.7% further shrinkage
#2 Fajada Butte	10/YR 7/2	10YR 8/4	1	Good	None	11.0 x	11.1	10YR 6/3	4.3% further shrinkage
#3 Fajada Butte	10/YR 6/2	5YR 6/6	5	Good	Minor	9.9 x	10.7	5YR 4/4	Bloated 4.7x
#4 Fajada Butte	2.5Y 6/2	7.5YR 7/6	4	Sticky	Major	12.0 x	11.3	5YR 4/4	Minor bubbles and swelling
#7 Una Vida	10YR 6/1	10YR 8/3	1	Good	Minor	12.6 x	12.0	10YR 8/6	Bloated 2.3x, Warped, blist
#8 Una Vida	10YR 6/2	10YR 7/3	1	Fair	Minor	9.4 x	9.5	10YR 8/6	Bloated 0.6x
#9 Una Vida	10YR 6/2	7.5YR 7/6	4	Good	None	12.6 x	10.8	10YR 5/1	Bloat 0.8x th. + shrink 6-7%
#10 Kin Klizhin area	2.5Y 7/2	7.5YR 7/6	5	Good	None	12.1 x	11.7	5YR 4/3	Min. further shrinkage
#11 Kin Klizhin	2.5Y 6/2	5YR 7/6	5	Good	None	14.3 x	12.1	5YR 4/4	Bloat 0.8x th. shrink 5-8%
#12 Kin Klizhin area	10YR 6/2	7.5YR 7/6	4	Good	Firing	10.2 x	8.8	2.5YR 4/4	3% further shrinkage
#14 Gallo Canyon	10YR 6/2	5YR 7/4	3	Fair-Poor	Minor	7.4 x	7.0	10YR 7/5	-----
#15 Gallo Canyon	10YR 6/2	5YR 7/4	3	Good	Minor	10.5 x	10.9	7.5YR 5/6	-----
#19 Chaco/residence area	10YR 7/2	7.5YR 8/4*	2	Good	None	7.4 x	8.7	---	-----
#21 South Addition	2.5Y 6/2	7.5YR 7/6	4	Sticky	Major	13.3 x	13.7	—	-----
CLIFF HOUSE FORMATION									
#17 Above Chetro Ketl	2.5Y 6/2	7.5YR 7/6	4	Good	Minor	11.7 x	10.8	7.5YR 5/4	3-6% further shrinkage discolor rind
#18 Above Chetro Ketl	10YR 7/2	5YR 7/6	5	Fair-	None	5.0 x	6.3	2.5YR 6/8	-----
#20 Atlatl Cave area	2.5Y 6/2	7.5YR 7/6*	4	Good	None	8.2 x	9.9	—	-----
LEWIS SHALE									
#16 Pueblo Alto	5Y 7/3	2.5YR 6/6	6?	Fair-	None	3.1 x	5.1	10YR 8/3	Vitrification spots
ALLUVIAL									
#5 Chaco Wash bottom	10YR 6/2	7.5YR 7/6	4	Fair	None	5.3 x	7.4	2.5YR 3/4	8% further shrinkage
#6 Chaco Wash walls	5YR 7/2	7.5YR 7/4	2	Fair	Minor+	12.2 x	12.6	10YR 6/4	Vitrification spots, slight expansion
#13 Kin Klizhin stock pond	2.5Y 7/2	5YR 6/6	5	Sandy Poor	None	1.0 x	4.8	7.5YR 5/8	-----
CONTROLS									
SY Morrison Formation near San Ysidro, NM	10R 5/6	2.5YR 5/8	6?	Fair-	Minor	6.5 x	6.6	2.5YR 3/4	Bubbled, melted
AQ Albuquerque South Valley river clay	5YR 6/2	2.5YR 6/8	6	Good	None	4.2 x	8.8	2.5YR 3/4	Bloated, vitrified
CS Commanche Springs	5YR 5/4	2.5YR 6/8	6	Good	Major	3.9 x	8.2	10R 4/6	Vitrified spots, some expansion

* 950° C.

workability of this sample was only fair, but shrinkage was minimal and there was no cracking. Subjectively, it seems unlikely that this would have been a source for pottery clay.

Alluvial Samples. Two samples were taken from the Chaco Wash in the vicinity of Fajada Butte. These samples were not as easily worked as the majority of the Menefee samples and contained more organic material. They exhibit a wide range of shrinkage. The third sample was from the stock pond west of Kin Klizhin and contained too much sand to be good pottery clay.

Firing Color

The oxidation colors of some of these samples is something of a surprise, given the conventional wisdom that Cretaceous clays from the central Chaco Basin fire buff (Tables 2.50 and 2.51). Although 15 (71 percent) fired buff or red-orange (Windes [1977: 292] color groups 1-4), nearly a fifth (19 percent) were in the darker yellowish-red to reddish-yellow group (Windes color Group 5). The Lewis Shale specimen (No. 13) oxidized light red, but it has poor working qualities. Of those in color Group 5, one is from the suspect stock pond location and did not work well; the other is from the Cliff House Formation with only fair workability. There are, however, two Menefee Formation samples that worked and dried well and fall into color Group 5. It must be noted that the difference between color Groups 4 and 5 is only one point on the hue scale (7.5YR 7/6 is color Group 4, while 5YR 7/6 is color Group 5), but the Group 4-Group 5 break has been used elsewhere (e.g., Toll et al. 1980). Three of the five Menefee Formation samples which are in color Group 4 (reddish-yellow to brown) have good working and drying qualities. Franklin's (1982:924) results from the geologically younger formations in the Bis sa'ani community area (Tertiary Kirtland-Fruitland) also fall in the yellowish-red range. Polishing causes a noticeable difference in color, although it usually only consists of slightly darkening the surface.

The firings at 1250° C give further evidence of variability of properties within formations. Colors again vary; the colors of the high-fired tiles are usually similar in color to the 910° C tiles, but they are darker and have more chroma. There are even greater differences in other attributes. Within the Menefee Formation samples, there are some that show little alteration, some that shrank from the dry size (possibly due to warping in some cases), some that show minor bloating, and some that bloated dramatically. Another result of high-firing was the presence in some tiles of small black vitrified spots. Similar spots are sometimes visible in sherds, suggesting that some clays contain materials with considerably lower vitrification points than the bulk of the material.

Table 2.52 shows oxidation colors of sherds from several Chaco Project sites. Only sherds with sherd and sandstone temper—those that are possibly of local production—are included (chalcedonic cement sandstone specimens are not included). It is apparent that the distribution of clay sample colors (Table 2.51) is quite different from the distribution of sherd oxidation colors (Table 2.52), with a far higher percentage of the sherds falling in the buff (Groups 1 to 3) range than do the clay samples and reddish-yellow colors being more common in the clay samples. Very red clays (Windes Groups 6 and 7) probably do not occur in the Chaco area and these clays are quite common in trachyte-tempered ceramics and in polished smudged wares (e.g., McKenna 1992; Toll et al. 1980; Windes 1977). Sherds that refire in Groups 4 and 5, which do occur but are rare, remain difficult to place by source.

The various clay testing results contain two lessons: 1) there is considerable variability in oxidation color of clays from a single formation even within a small area; and 2) apparently usable clays from near central Chaco Canyon can contain considerable oxidation color. The variability within formations warns against the practice of excluding an area as a production area solely on the basis of oxidation colors without a very thorough clay sampling program. As noted by several students (e.g., Bubemyre and Mills 1993; Garrett and Franklin 1983; Toll et al. 1980; Windes 1977), Cibola Whitewares and Graywares show a preference for buff-firing clays (Table 2.52). At this point, it cannot be said whether this is indicative of area of manufacture or selectivity for particular sources. Similarly, the presence of ranges of oxidation color in ceramics may mean that ceramics were being produced by a number of different potters using

Table 2.51. Summary of oxidation colors of Chaco clay samples.

	Color Group				
Formation	1-3	4	5	6	Total
Menefee	7	5	2	-	14
Cliffhouse	-	2	1	-	3
Lewis Shale	-	-	-	1	1
Alluvial	1	1	1	-	3
TOTAL	8	8	4	1	21

Table 2.52. Summary of oxidation colors from sandstone and sherd-tempered sherds from Chaco Project sites.

	Color Group				
Ware Group	1-3	4	5	6	Total
Early whiteware	114	18	9	-	141
Early grayware	38	4	1	-	43
Middle whiteware	49	3	3	1	56
Middle grayware	42	2	4	-	48
Late whiteware	35	1	2	-	38
TOTAL	278	28	19	1	326

Refiring samples are from the following sites:
29SJ 628, n = 26 (Toll and McKenna 1980:50-51); 29SJ 629, n = 26 (Toll and McKenna 1993:Appendix); 29SJ 627, n = 100 (Toll and McKenna 1992:153; McKenna 1992); 29SJ 1360, n = 72 (McKenna and Toll 1984:465-468); Pueblo Alto/29SJ 389, n = 104 (Toll and McKenna 1987:Tables 144, 145).

Early whiteware includes types through Red Mesa Black-on-white.
Early grayware includes types through Neck Corrugated.
Middle whiteware includes Gallup, Puerco and Escavada Black-on-whites.
Middle grayware includes PII and PII-III Corrugated.
Late whiteware includes late carbon-on-white types.

particular sources consistently. Alternatively, oxidation color may be insignificantly related to properties more important in the production of pottery, which allowed acquisition of clay from a range of sources.

Ceramic Import to Chaco Canyon

Ceramic import has traditionally been discussed on typological grounds through the identification of "trade wares." While there is a considerable segment of trade wares in the Chaco assemblage, it is only part of the picture of ceramic movement. Anna Shepard, perhaps the foremost figure in American archeological studies of ceramics, had a long association with research in Chaco Canyon, beginning with attendance at the University of New Mexico field school in 1929. Unfortunately, she was never employed to do an intensive analysis of Chaco pottery, but she did examine groups of Chaco sherds for comparative purposes for Earl Morris, and on a limited basis, for Neil Judd (Shepard 1939; Judd 1954:234-238). During those analyses she confirmed the presence of nonlocal igneous temper in about half of the corrugated utility wares and significant numbers of the whitewares. She concluded that the graywares were likely to have been imported as vessels (not raw material) from the Chuska Valley. Judd found this hard to believe, given a widely held assumption that pueblos were self-sufficient (this assumption is still held to some degree: Plog 1980b). The Chaco Project took place during a wave of archeological interest in regional analyses, which the ceramic analysis reflects.

It is now hard to think of Chaco as a local phenomenon. Shepard's then radical suggestions have been broadened, elaborated, and verified (e.g., Mills et al. 1997; Stoltman 1996). While it is still not possible to fully comprehend the diversity of production and quantity of import, the information available allows various estimates of ceramic import. The focus here is on intra-regional ceramic movement, partly because the volume of that movement was greater than extra-regional import and partly because exchange within the region will improve understanding of the operation of the Chaco system.

There are two basic means of recognition of nonlocal ceramics; through stylistic identification and through identification of distinctive nonlocal tempers. The wares present in Chaco change significantly through time (Table 2.53, Figure 2.10). While the approximate areas of production shown in the figure are most pertinent to A.D. 1000 and A.D. 1100, most are relevant to earlier times as well (Table 2.53). Identification of products from the San Juan and Chuskan areas is based primarily on temper and secondarily on style and surface treatments. Some ceramics from nearer to Chaco Canyon, including the San Juan and Chuska areas, are difficult to identify using stylistic and surface treatment criteria. Those from greater distances, such as the Tusayan wares, are more readily identified from surface attributes. The redwares (which includes orangewares) and polished smudged wares are all, of course, distinctive from the more numerous gray and whitewares. There is also little difficulty in separating the three primary redwares from one another. Using the broad framework of Table 2.53 and Figure 2.10 as a basis, what we know of ceramic import to Chaco Canyon through time can be discussed in some detail.

Time Placements

The chronological significance of types is of great archeological consequence (Breternitz 1966). Using the accumulated archeological experience of long study of temporal ceramic change, with verification through absolute dating, a time group of varying specificity was assigned to nearly all proveniences at all sites excavated by the Chaco Project (an enormous task undertaken by T. C. Windes and C. M. Cameron). While some ancillary information entered into these time assignments, they were based primarily on ceramic groups (Colton 1953:65-67; Windes 1977:281-282). There are some problems of circularity in using the time groups to assess temporal trends in ceramics, but this circularity is of less than major concern here because the results are intended to reveal trends, not precise figures.

Using ceramics from the survey of additions to the Chaco Park, Mills (1986) generated date clusters. This more formal approach to date assignment resulted in five date ranges which are quite similar to those used here (Table 2.54). Mills' larger time group for A.D. 700 to 880 is probably a better approximation of a realistic group because our A.D. 800 to 920 group is chronically under-represented. Using A.D. 890 as a starting date for the A.D. 890 to 1025 range also makes sense because Red Mesa Black-on-white pottery, a critical A.D. 920 to 1040 type, was probably made before A.D. 900. Ceramic basis for separating Mills' first two groups is, however, scant in our typological system. Mills' somewhat earlier assignment for A.D. 1030 to 1130 is likely from assigning Puerco and Gallup Black-on-whites starting dates of A.D. 1000 (Mills 1986:Table 10), which seems a bit early (we use A.D. 1030). Our breakpoints of A.D. 1040 and A.D. 1100 revolve around the beginning of Gallup Black-on-white and of carbon-painted ceramics, respectively. We also use post-A.D. 1200, based mainly on the appearance of Mesa Verde Black-on-white and St. Johns Polychrome. On the whole, Mills' groups are sufficiently close to provide welcome corroboration. There is some autocorrelation as she used mostly the same dates for types as did the Chaco Project, but her sherd assemblages provide independent groups.

Our approach, taken to achieve a temporal series divided into time blocks of interest, is a compromise between the ideal and the practical. Our current dating of Chaco ceramics identifies two types which coincide fairly well with time groups and can be directly assigned to time groups: neck-corrugated and Chaco McElmo Black-on-white. Most types, however, have production and/or use spans that cover 200 years or more and many ceramic categories are lost to analysis because they have even broader chronological limits. Types with greater than 100 years have periods of high popularity; for instance, the practice of assuming that Gallup Black-on-

Table 2.53. Major ceramic groupings found in Chaco Canyon.

Area/Ware	Time Span A.D.	Relative Within-Ware Occurrence in Chaco			Primary Chaco Project I.D. Criteria	References
		Early	Mid.	Late[a,b]		
SAN JUAN RIVER/MESA VERDE, MONTEZUMA VALLEY, SOUTHEAST UTAH						Breternitz et al. 1974
Mesa Verde Grayware	500-1300	few	few	few	Andesite temper	Abel 1955
Mesa Verde Whiteware	575-1300	mod	few	mod	Temper, crackled slip, design	
San Juan Redware	700-1000	dom	abt	abs	Temper, surface	Lucius & Breternitz 1981; Abel 1955
CHUSKA VALLEY						
Chuska Grayware	700-1300	mod	dom	dom	Trachyte temper	Windes 1977
Chuska Whiteware, carbons	850-1300	mod	dom	abt	Temper, paint, slip	Windes 1977
Chuska Whiteware, mineral	900-1100	few	mod	abs	Temper	Windes 1977
Chuska Redware	700-900	few	abs	abs	Temper	Peckham and Wilson 1964
CHACO/SAN JUAN BASIN/RED MESA VALLEY						
Lino Gray and Fugitive[c]	500-900	dom	few	abs	Surface, temper	Colton and Hargrave 1937
Lino Black-on-gray[c]	500-725	dom	few	abs	Surface, paint, design	Colton and Hargrave 1937
Lino Smudged[c]	600-775	mod	few	abs	Surface, temper	Wendorf 1953
Cibola Whiteware, Chaco	700-1175	dom	dom	abt	Sherd and sand temper, slip, design	Windes 1977, 1984b; Vivian 1959; Gladwin 1945
Cibola Grayware, Chaco	700-1200	dom	abt	abt	Sand temper	Windes 1977; Hawley 1936
NORTHEASTERN ARIZONA						
Tusayan Whiteware	725-1300	few	few	mod	Carbon paint, paste, polish, design	Colton and Hargrave 1937
Tsegi Orangeware	1050-1200	abs	few	mod	Sand temper, design, color	Colton and Hargrave 1937; Colton 1956
Little Colorado Whiteware	1075-1250	abs	rare	rare	Polish, paste, slip, paint	Colton and Hargrave 1937
SOUTHWEST NEW MEXICO, EAST CENTRAL ARIZONA						
Mogollon Brownware						
Woodruff Brown	300-800	dom	few	abs	Paste, surface	Colton and Hargrave 1937
Woodruff Red	300-800	abt	abs	abs	Surface color	Colton and Hargrave 1937
Forestdale Smudged	300-1150	mod	dom	dom	Surface, temper	Haury 1940; Breternitz 1966
EAST CENTRAL ARIZONA AND WEST CENTRAL NEW MEXICO						
White Mountain Redware	1000-1500	abs	abt	dom	Slip, paste, design	Carlson 1970

Table 2.53. *(continued)*

Area/Ware	Time Span A.D.	Relative Within-Ware Occurrence in Chaco Early	Mid.	Late[a,b]	Primary Chaco Project I.D. Criteria	References
MIDDLE RIO GRANDE TO ACOMA						
Socorro Black-on-white	1050-1275	abs	rare	rare	Unslipped surface design, temper	Sundt 1979; Dittert 1959
Cebolleta Black-on-white	—	abs	rare	rare	Slip, polish, design	Dittert 1959

Dates based on Breternitz 1966 and adjusted according to Chaco Project and other results.

[a] Early = approximately A.D. 500-1000; mid = approximately A.D. 1000-1130; late = approximately A.D. 1130-1250.

[b] Ordinal occurrence ratings: absent (abs), rare, few, moderate (mod), abundant (abt), dominant (dom).

[c] The Lino types are also attributed to Arizona.

white comes from the period A.D. 1040 to 1100 has probabilistic backing. Still, the time span now in use for Gallup Black-on-white is A.D. 1030 to 1200, so the A.D. 1040 to 1100 assumption has considerable chance for misplacement. One antidote for this problem--made possible with the use of the time groups and a computer—is to break up types such as Gallup Black-on-white, as well as even broader "generic" groups such as plain gray, decorated redware, or unidentified corrugated, into time group segments based on provenience. This approach allows placement of more sherds than a strictly typological approach and refines the placement of many sherds, but it also runs into practical problems. At sites having considerable mixing of deposits, substantial percentages of samples are ignored because large portions of collections can only realistically be assigned to long-time segments with little utility for the analysis under discussion.

There is, however, a compromise: types falling mostly within a single time segment are placed directly in that segment (Table 2.55 presents actual type placements and shows the weighting scheme described here). Types covering two or more segments are placed in time groups by provenience time assignment of 100 years or less, as long as that assignment falls within the type's estimated time span. All other examples' specific types are placed in their probable time segment, whether or not they were found in a provenience assigned to it. All generic types are placed strictly by provenience time assignment, using only sherds from provenience time groups of 100 years or less. This procedure includes the maximum possible number of sherds with considerable refinement and solves some of the mixing and heirlooming problems inherent in archeological deposits. It would be possible to make the time weighting scheme even more elaborate through the consideration of other deposits or time groups of greater than 100 years, or by placing sherds in the nearest "acceptable" time group for a type. The present system, however, remains explicable and covers most cases; the gain from additional elaboration is questionable.

The system is not, of course, remotely perfect. Table 2.56 gives an assessment of the size of error it engenders, assuming that the dates assigned to types and time segments are valid. Probably the worst

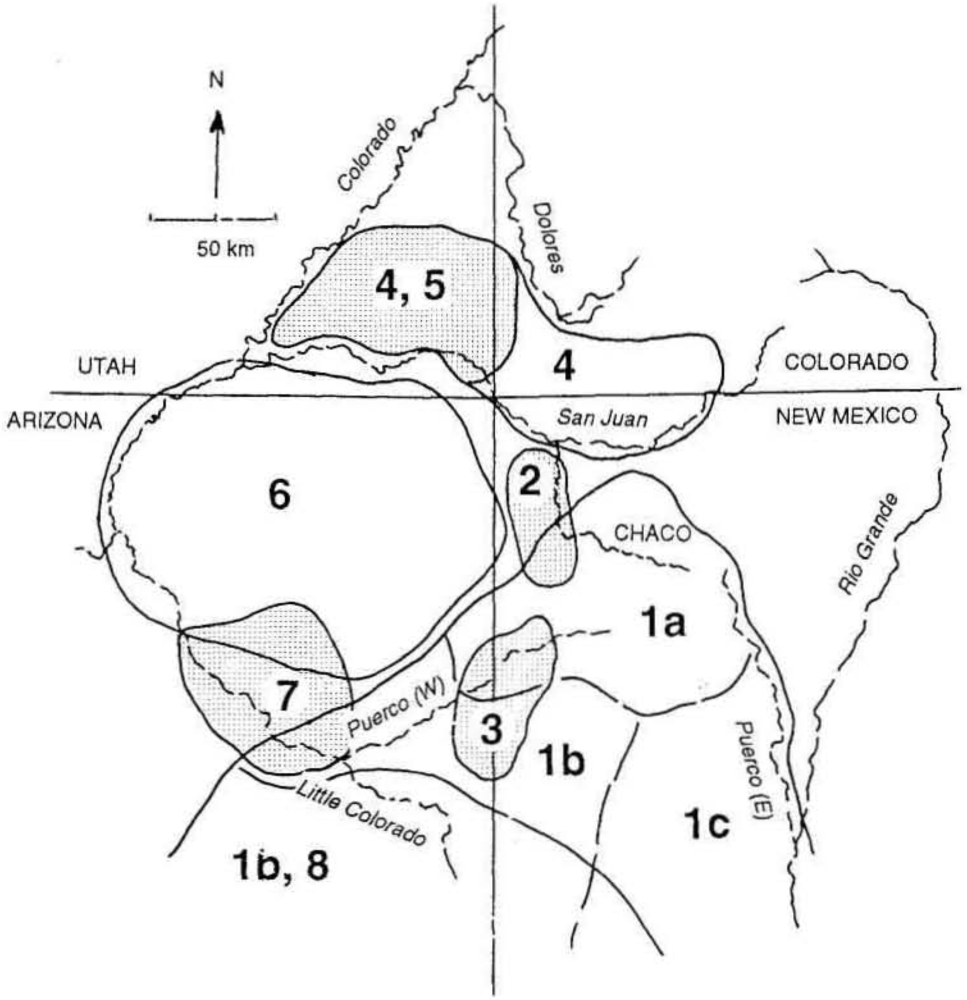


Figure 2.10. Map showing approximate areas of production of ceramics found in Chaco Canyon in the eleventh and twelfth centuries. The areas shown are compiled from a number of sources; it is not really possible to surround those areas with lines, but areas of high frequency are estimated.

Key:

1. *Cibola White and Gray*
   - *1a. Chaco*
   - *1b. Reserve*
   - *1c. Socorro/Cibolleta*
2. *Chuska White and Gray*
3. *White Mountain Redware*
4. *San Juan White and Gray*
5. *San Juan Redware*
6. *Tusayan White and Gray, Red, Tsegi Orangeware*
7. *Little Colorado White*
8. *Polished Smudged*

Table 2.54. Date ranges used by Mills (1986) and the Chaco Project staff.

Project	A.D.				
Mills (1986)	550-750	700-880	890-1025	1030-1130	1130-1230
Present Use	pre-800	800-920	920-1040	1040-1100	1100-1200

distortion that procedure causes is that items from extreme temporal tails of a type are placed in the central, most abundant segment of a type. The only happy things that can be said about that are that the "tail" sherds are not numerous and that their presence in the tails may well result from factors other than time of production or import.

There are a few types which seem to disagree with time placements of either the type or the proveniences. The poorest match is wide neckbanded, which shows as having 76 percent of the cases in proveniences with the "wrong" time assignment. The majority (70 percent) of wide neckbanded specimens come from proveniences dated A.D. 920 to 1040, which suggests that wide neckbanded was probably made well past A.D. 900. Contributing to this poor placement is the fact that very few items were assigned to the A.D. 800 to 920 group (2.4 percent of the total), while the A.D. 920 to 1040 group is by far the largest in the sample (37.0 percent). While this imbalance is likely to enhance later counts through hold-over items, it is also likely that wide neckbanded is considered to have ended earlier than it did. The same may be said of the Basketmaker III-Pueblo I decorated whitewares, though the level is much less than in wide neckbanded and is probably more attributable to curation. Pueblo III Corrugated is subject to the reverse problem—its time span appears to have been placed too late. Proveniences judged to fall in the "appropriate" time segment for Pueblo III Corrugated are very few; therefore, probability is high of recovery from a provenience assigned an earlier date. While it is likely that these types' assigned production spans are too restrictive, it is also fairly safe to assume that the items that occur in "wrong" contexts are likely to be at the early (e.g., wide neckbanded) or late (Pueblo III Corrugated) extremes of that time period so that placement by default serves to emphasize trends even if some correctness in chronology is sacrificed.

Definition of Import: Conservatively

A problem complementary to dating is determining what can reasonably be considered imported. A two-staged approach is taken here: first, a conservative baseline is established, and second, a more liberal, though less secure, estimate is made using additional assumptions. In the conservative baseline, vessels are considered imports if their temper is one of the four listed in the table—trachyte, chalcedonic sandstone, Socorro, or San Juan igneous—or if they can be identified as nonlocal from surface characteristics such as in the San Juan or Tusayan series. If an item is typologically exotic and has an exotic temper, it is listed in the table under the temper.

The very abundant sand, and sand and sherd-tempered classes in both the graywares and whitewares (Figures 2.2A, B, C) are considered non-imports here, unless a whiteware item is identified typologically as an import. The temper class is so large and the use of these materials so widespread that it is inevitable that there are vessels represented that were made at least as far from Pueblo Alto as some of those with tempers taken to signify import (see Zedeño and Mills 1993; Zedeño et al. 1993). Also excluded from import status are unidentified igneous and more-sandstone-than-trachyte mixes, portions of which are also likely to be imports. Some uncontrolled compensation for this conservatism is present in that the material from 29SJ 627 (the largest single site collection) was not differentiated as to mixes with more-sandstone-than-trachyte. This creates some inflation of the trachyte counts mostly in whitewares (see Temper Section).

Carbon Paint

Typological determination of imports is based on the recognition of constellations of attributes that characterize ceramic series other than the Chaco

Table 2.55. Method of temporal placement of types showing default time segments and time spans for each type.

Type	Project Time Group	Pre-800	800-920	920-1040	1040-1100	1100-1200	1200+
Lino Gray Fugitive	2, 3, 4, 5, 24	xxxxxx	xxxxxx				
"Obelisk Gray"	2, 3, 4, 5, 24	xxxxxx	xxxxxx				
BMIII-PI Mineral-on-white	2, 3, 4, 5, 24	xxxxxx	xxxxxx				
BMIII-PI Carbon-on-white	2, 3, 4, 5, 24	xxxxxx	xxxxxx				
Wide Neckbanded	4, 5	xxxxxx	xxxxxx				
Plain Grayware	3, 4, 5, 6, 18, 24	xxxxxx	xxxxxx	xxxxxx			
Early Red Mesa Black-on-white	5, 6, 18		xxxxxx	xxxxxx			
Narrow Neckbanded	5, 6, 18		xxxxxx	xxxxxx			
Red Mesa Black-on-white	5, 6, 18		xxxxxx	xxxxxx			
Chuskan C/w Red Mesa design	5, 6, 18		xxxxxx	xxxxxx			
Neck Corrugated	6, 18		xxxxxx				
Pueblo II Corrugated	6, 18, 7, 8		xxxxxx	xxxxxx	xxxxxx		
Escavada Black-on-white	6, 18, 7, 8		xxxxxx	xxxxxx	xxxxxx		
Puerco Black-on-white	6, 18, 7, 8		xxxxxx	xxxxxx	xxxxxx		
Gallup Black-on-white	6, 18, 7, 8		xxxxxx	xxxxxx	xxxxxx		
Chuska Black-on-white	7, 8			xxxxxx	xxxxxx		
Chaco Black-on-white	7, 8			xxxxxx	xxxxxx		
Pueblo II-III Corrugated	7, 8, 12			xxxxxx	xxxxxx	xxxxxx	
Chaco McElmo Black-on-white	8			xxxxxx			
Tusayan Carbon-on-white	7, 8, 12			xxxxxx	xxxxxx	xxxxxx	
Pueblo II-III Carbon-on-white	7, 8, 12			xxxxxx	xxxxxx	xxxxxx	
Pueblo III Corrugated	8, 12			xxxxxx	xxxxxx		
Mesa Verde Black-on-white	8, 12			xxxxxx	xxxxxx		
Polychrome Redwares	8, 12			xxxxxx	xxxxxx		
Chuskan Carbon-on-white	5, 6, 18, 7, 8, 12		xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
PII-III Mineral-on-white	5, 6, 18, 7, 8, 12		xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Unidentified Corrugated	6, 7, 8, 12, 18		xxxxxx	xxxxxx	xxxxxx	xxxxxx	
Exotic Mineral-on-white	all	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Plain and Decorated Redware	all	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Polished Smudged Ware	all	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Plain Whiteware	all	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Brownware	all	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx	xxxxxx

Underlining indicates time period into which an item was placed if it lacked other "appropriate" time assignment.

Project time groups are labelled as follows.

Code	Range	Code	Range
02	A.D. 500's	14	A.D. 1120-1300
03	A.D. 600's	15	A.D. 500-1200
04	A.D. 700-820	16	A.D. 920-1320
05	A.D. 820-920	17	A.D. 1120-1320
06	A.D. 920-1020	18	A.D. 1020-1040
07	A.D. 1020-1120	19	A.D. 700-1020
08	A.D. 1120-1220	20	Unknown
09	A.D. 920-1120	21	A.D. 1020-1220
10	A.D. 920-1220	22	A.D. 900-1130
11	A.D. 820-1220	23	A.D. 820-1120
12	A.D. 1220-1320	24	A.D. 600-820
13	A.D. 820-1020		

Table 2.56. *Correspondence of type default placement with time group occurrence. "Wrong" indicates cases in which a type falls in a segment not within its assigned span; all cases with time assignments included.*

Type	Project Time Group	Type n	% of Type in Default	% of Type in Short Spans	% of Type in Broad Spans	% of Type Wrong	% Sample in Default
Lino Gray and Fugitive	2, 3, 4, 5, 24	845	59.1	61.7	81.7	18.3	2.5
Obelisk Gray	2, 3, 4, 5, 24	535	94.4	94.4	98.7	1.3	2.6
BMIII-PI Mineral-on-white	2, 3, 4, 5, 24	1,047	51.2	56.8	71.3	28.7	2.7
BMIII-PI Carbon-on-white	2, 3, 4, 5, 24	281	40.2	43.1	68.7	31.3	0.6
Wide Neckbanded	4, 5	288	8.3	14.2	23.3	76.7	0.1
Plain Grayware	2, 3, 4, 5 6, 18, 24	756	-	83.7	93.0	7.0	-
Early Red Mesa B/w	5, 6, 18	374	66.3	72.2	95.2	4.8	1.3
Narrow Neckbanded	5, 6, 18	634	57.3	60.9	83.8	16.2	1.8
Red Mesa Black-on-white	5, 6, 18	3,670	66.3	70.1	95.4	4.6	12.4
Chuskan C/w Red Mesa design	5, 6, 18	129	62.0	67.4	86.8	13.2	0.4
Neck Corrugated	6, 18	228	75.0	75.0	93.9	6.1	0.9
Pueblo II Corrugated	6, 18, 7, 8	1,004	33.4	66.8	99.2	0.8	1.7
Escavada Black-on-white	6, 18, 7, 8	209	49.3	78.0	98.6	1.4	0.5
Puerco Black-on-white	6, 18, 7, 8	525	42.9	69.1	99.4	0.6	1.1
Gallup Black-on-white	6, 18, 7, 8	1,642	53.4	79.3	99.5	0.5	4.5
Chuska Black-on-white	7, 8	112	50.0	65.2	83.9	16.1	0.3
Chaco Black-on-white	7, 8	71	12.7	56.3	93.0	7.0	0.05
Pueblo II-III Corrugated	7, 8, 12	225	32.4	49.8	86.2	13.8	0.4
Chaco McElmo Black-on-white	8	90	78.9	78.9	94.4	5.6	0.4
Tusayan Carbon-on-white	7, 8, 12	88	14.8	43.2	86.4	13.6	0.1
Pueblo II-III C/w	7, 8, 12	232	33.2	38.8	75.9	24.1	0.4
Pueblo III Corrugated	8, 12	103	1.0	32.7	68.3	31.7	0.01
Mesa Verde Black-on-white	8, 12	42	14.3	21.4	85.7	14.3	0.03
Polychrome Redwares	8, 12	8	-	100.0	100.0	-	-
Chuskan Carbon-on-white	5, 6, 18, 7, 8, 12	239	-	79.5	99.2	0.8	-
Unidentified Corrugated	6, 7, 18, 8, 12	1,435	-	85.4	98.4	1.6	-
Pueblo II-III M/w	6, 18, 7, 8, 12	2,407	-	70.8	98.7	1.3	-
Exotic Mineral-on-white	all	385	-	65.5	100.0	-	-
Plain and Decorated Redware	all	485	-	78.6	100.0	-	-

Table 2.56. *(continued)*

Type	Project Time Group	Type n	% of Type in Default	% of Type in Short Spans	% of Type in Broad Spans	% of Type Wrong	% Sample in Default
Polished Smudged Ware	all	384	-	81.5	100.0	-	-
Plain Whiteware	all	1,087	-	71.8	100.0	-	-
Brownware	all	75	-	94.7	100.0	-	-
TOTAL		19,635	6,819	13,795	18,241	1,404	-
Percent			34.7	70.2	92.9	7.1	

Sum of no default % = 37.0.

Groups including more than 120 years are considered "broad time spans"; items from these time groups are placed in default span for types having a time default, or disregarded in time analysis if they have no default.

Default time groups are 120 years or less except for pre-A.D. 800.

% in broad spans are only those types that overlap with the span assigned to the type.

Column calculation

% of type in default: n in underlined or single time segment shown in Table 2.55; total n in type.

% of type in short spans: n in segments $\leq$ 120 years placed by provenience (includes default) ÷ type n.

% in broad spans: n of all type occurrences in segments overlapping with assigned span ÷ type n.

% of type "wrong": n of occurrences in segments that do not overlap with assigned span ÷ type n.

% sample in default: n of all items in a particular default time segment ÷ 19,635 (overall total).

Cibola Series (Table 2.53). Some of these attributes are technological (temper, paint type, polish, and slip) and others are stylistic. In some cases, temper can be equated with geology and, therefore, can be used as a sole determinant of import. Paint type is an essential criterion in most decorated types in this analysis, but must be used in concert with other attributes to determine likelihood of local production. Carbon-painted whitewares are, in most cases, given type names that imply nonlocal production, but that assumption stems more from nomenclature than physically verified fact. If abundance is used as an index of nearness of manufacture—an index shown to be far from infallible by high frequencies of trachyte-tempered pottery in Chaco Canyon—then ceramics with carbon paint were not locally produced for the bulk of the Anasazi sequence. For the best ceramically represented part (roughly A.D. 900 to 1100), the carbon paint nonlocal equation seems reasonably assumed. Most carbon-painted specimens from that period may be corroborated as being nonlocal by the presence of trachyte temper and/or distinctive slips, design, and to a lesser degree, pastes. Before and after that time, however, the situation is markedly more complicated. Use of organic paint in Basketmaker III and Pueblo I contexts is less well-localized than it is post A.D. 900. It is conventionally said that both mineral and carbon pigment were used in this period: for example, in the La Plata (Shepard 1939:254), Mesa Verde (Breternitz et al. 1974:25), and Navajo Reservoir (Eddy 1966:383-384) areas. While both pigments occur in several areas, there seems to be a general predominance of one or the other in most areas. Thus, in areas east of the Chuska Mountains and in southwestern Colorado, mineral paint is more common than organic paint (Mesa Verde, La Plata, Prayer Rock; Morris 1980:65). Refinement of dating suggests that there is also a temporal element within early whitewares with regard to paint type, with mineral paint tending to be earlier (Wilson 1995). There also seems to be an area of crudely equal occurrence in early types in the Canyon de Chelly area (Lucius 1980:Appendix I). In the heart of the Kayenta area, on Black Mesa for example, type occurrences suggest that carbon paint was used practically exclusively (e.g., Gumerman et al. 1972).

The carbon-mineral mixture in Chaco Canyon seems to be greater than that in some other areas, though there is some difficulty in obtaining actual proportions from sites elsewhere. Somewhat surprising are the proportions of the broad categories, "Basketmaker III-Pueblo I" polished and unpolished mineral-on-white and carbon-on-white from Chaco Canyon (Table 2.57A). It might be suggested a priori that mixtures of carbon and mineral paint in the earliest Anasazi decorated pottery are a function of early experimentation with ceramic decoration, in which a variety of pigments were used as traditions established themselves. The mineral-to-carbon ratios here, however, show the earliest sites as heavily dominated by mineral paint with insignificant carbon paint. This finding is echoed by the whole vessels reported from the Basketmaker caves just to the north of the Chuska Valley (Morris 1980:65). The ratio there is 30 mineral to 1 carbon, even though this area became a carbon paint bastion in subsequent centuries. Alternatively, the sequence in early paints in the Navajo Reservoir district moves from predominantly carbon paint to a mixture to exclusively mineral paint (Eddy 1966:383-384). It may be that some of the admixtures of paint reported for Chapin Black-on-white result from similar temporal cycling. In studying materials from the La Plata Valley, Wilson (1995) has concluded that the use of organic and mineral paint within Basketmaker III-Pueblo I probably has temporal significance. He notes that Shepard suspected that there was an areal basis for different paint use. As understanding of chronology has improved, it has become clear that areal occupation of the La Plata drainage changed considerably during the long period included in "Basketmaker III-Pueblo I," which would give the paint differences noted by Shepard an areal appearance (Toll and Wilson n.d.). This temporal, rather than spatial, shift seems to be supported in the ceramics from Chaco Canyon.

This complicates rather than clarifies the question of whether early carbon-painted ceramics found in Chaco Canyon are likely to be nonlocally produced. A customary method of testing for extra-canyon production is refiring under the assumption that red-oxidizing clays are not found in the central San Juan Basin. Only 14 early carbons have been included in project refiring tests (Table 2.57B). The refiring results are rather inconclusive for two reasons beyond sample size: 1) all of the oxidized colors fall within color ranges of clays found in and

Table 2.57. *Comparison of early carbon-on-white and mineral-on-white occurrence, refiring colors and tempers.*

A. Mineral and carbon paint by site:

Site	Mineral	Carbon	% Carbon	M:C Ratio
BMIII				
29SJ 423	46	3	6.1	15.3
29SJ 1659	30	1	3.2	30.0
29SJ 299	72	4	5.3	18.0
BMIII-PI				
29SJ 721	39	2	4.9	19.5
29SJ 628	207	143	40.9	1.4
PI				
29SJ 299-PI	22	4	15.4	5.5
29SJ 724	182	21	10.3	8.7
PI+				
29SJ 627	160	49	23.4	3.3
29SJ 629	187	35	15.8	5.3
29SJ 1360	92	23	20.0	4.0
TOTAL	1,037	285	21.6	3.6

B: Oxidation color:

		Color Group						
Oxidation	White	1	2	3	4	5	6	Total
Carbon	2	4	7	-	1	-	-	14
Mineral	9	3	6	7	1	3	1	30

C. Temper:

Temper	Undiff. SS	Sherd > SS	Chal. SS	Iron Ox. SS	San Juan Igneous	Trachyte	Trachyte +SS	Total
Carbon	191	3	2	18	17	43	9	284
Percent	67.5	1.1	0.7	6.4	6.0	15.2	3.2	
Mineral	738	84	34	46	97	27	8	1,034
Percent	71.4	8.1	3.3	4.4	9.4	2.6	0.8	

Color groups: 1-3 buff; 4-5 yellowish-red; 6 red (see Toll et al. 1980; Windes 1977:292).

around Chaco Canyon; and 2) early whiteware sherds, even with demonstrably nonlocal clays, tend to oxidize to light colors, as seen in the mineral-on-white data. "Ironically," the mineral or carbon sherds which oxidize white here are, perhaps, the best possibilities for nonlocal products because most Chaco Canyon clays have at least some oxidation color. There is also some association of white-burning clays with San Juan igneous temper.

It seems incorrect, then, to attribute the presence of both carbon and mineral paint in early decorated ceramics in single areas to the nascence of Anasazi pottery. The mixed use of pigments contrasts to practices on either side of the time scale. Insofar as tempers local to a type are present (such as crushed diorite in "Chapin Black-on-white"), the case for the use of both pigments in single areas seems reasonable, though time and within-temper area variation would be worth investigating. Both the existence of predominantly organic paint areas (northeastern Arizona) and the fact that decoration of pottery at this time is most remarkably homogeneous over the largest area (Plog 1980c, among others), leave room to wonder about sources for the scarcer early carbon-on-white ceramics. The attribution of carbon-painted pottery to "local" potters may be a holdover from the assumption that Anasazi villages, especially early ones, were autonomous and self-sufficient (Plog 1980b). This seems likely, but demonstration that it is the case would require thin sections, chemical analyses, and a broad temporal and areal base, none of which is currently available. For the present, it can only be noted that substantial movement of pottery was clearly taking place by the time (more or less Pueblo I) when the greatest mix of carbon and mineral pigments is present. It is likely that there was specialization of whiteware production as early as Basketmaker III (Wilson and Blinman 1995:71-72).

It remains to decide how to treat carbon-painted ceramics for the present purpose of estimating ceramic import levels. The mineral-carbon ratios in Table 2.57A may again be informative. Site 29SJ 628 is anomalous in several regards, notably the high frequency of San Juan temper and the frequency of carbon-painted ceramics. San Juan temper and carbon paint are not correlated at 29SJ 628 because 9.1 percent of the carbon-painted items are San Juan tempered, as compared to 26.1 percent of the mineral painted ones. At 29SJ 628, the carbon-painted items compose 41 percent of the decorated whitewares. By usual practice, a percentage this high would not be readily accepted as an import category on its own, but the complexity of the temper assemblage in both groups show that the paint dichotomy is a simplistic one. At all of the other sites and for all sites combined (disregarding the temporal differences), the carbon wares are less than a quarter of the decorated pottery, which might be considered more "reasonable" for an import level. When the known exotic tempers in the carbons and minerals are compared, it is clear that they are differently composed; most notably, 18 percent of the carbons are trachyte-tempered, while only 3 percent of the mineral-painted early sherds are trachyte-tempered (Table 2.57C). The two paint types are differently composed, but at the same time they were apparently in use in several areas (<u>all</u> areas at the level of discrimination possible here). Since the import summary table (Table 2.58) is designed to give conservative estimates of total import to the canyon, early carbon-painted ceramics are not considered to be imported by the sole criterion of paint type, <u>even though</u> it is more likely that sandstone-tempered carbon-on-white pottery was not locally made. A substantial portion of the carbon-painted ceramics is considered imported because it is trachyte-tempered.

The same considerations and dilemmas apply to the post-A.D. 1000 carbon-painted ceramics found in Chaco Canyon. Once again, there is a category—Chaco McElmo Black-on-white—considered to have been locally made (Windes 1984b, 1985). The superficial recognition of pottery in this class is based on a rather tight definition; carbon wares that are less carefully decorated, polished, or fired are often called McElmo Black-on-white and the purely typological assumption is made that such pottery is nonlocal. Again, a substantial portion <u>is</u> trachyte-tempered (Table 2A.26), but some is not; moreover, some Chaco McElmo also contains at least some trachyte. Franklin (1982:879-885) recognizes and discusses the likelihood that some sand or sherd and sand-tempered, carbon-painted ceramics from this late period that do not fit the description for Chaco McElmo Black-on-white were nonetheless locally made and devised a category called Cibola Carbon-on-white. Shepard examined a small group of late carbon-painted sherds from Chaco Canyon and found seven different temper classes; two of these correspond to the categories called trachyte and San Juan igneous here; the rest were combinations of sherd and sandstone considered here to be possibly local. Shepard thought it likely that some of the carbon-painted, sherd-tempered pottery from Chaco Canyon was made there (see Vivian 1959:26-28). The use of carbon paint in the eastern Anasazi area seems to experience a remarkable surge around A.D. 1100. With the re-establishment of more general usage of carbon paint, the same conservative approach to import estimate as made for the early sherds applies. Unless they are recognizably from

Table 2.58. Summary of identifiable ceramic imports through time at all Chaco Project sites combined.

	Import									
	Grayware		Whiteware		Redware		Smudged		Overall	
Time/Identification	No.	%	No.	%	No.	%	No.	%	No.	%
Pre-A.D. 800										
Trachyte	16	1.0	83	5.9	16	12.4	1	0.9	116	3.6
Chalcedonic SS	8	0.5	37	2.6	-	-	1	0.9	46	1.4
San Juan	9	0.6	118	8.3	20	15.5	-	-	147	4.6
Socorro	-	-	1	0.1	-	-	-	-	1	.0
Typological	63[a]	4.0	3	0.2	93	72.1	64[b]	58.2	223	6.9
Total import	96	6.0	242	17.1	129	-	66	60.0	553	16.6
Total n	1,560		1,417		129		110		3,216	
Ware % of import		18.0		45.4		24.2		12.4		-
Ware % of total		48.5		44.1		4.0		3.4		-
A.D. 800-920										
Trachyte	40	11.9	21	6.8	3	30.0	-	-	64	9.7
Chalcedonic SS	58	17.2	29	9.4	-	-	-	-	87	13.2
San Juan	4	1.2	18	5.8	6	60.0	-	-	28	4.3
Typological	-	-	4	1.3	1	10.0	1[b]	-	6	0.9
Total import	102	30.6	72	23.4	10	-	1	-	185	28.1
Total n	337		308		10		3		658	
Ware % of import		55.1		38.9		5.4		0.5		-
Ware % of total		51.2		46.8		1.5		0.5		-
A.D. 920-1040										
Trachyte	424	28.2	516	8.5	10	8.9	-	-	950	12.3
Chalcedonic SS	169	11.2	445	7.3	-	-	1	1.6	615	7.9
San Juan	14	0.9	122	2.0	87	77.7	-	-	223	2.9
Socorro	-	-	5	0.1	-	-	-	-	5	0.1
Little Colorado	-	-	4	0.1	-	-	-	-	4	0.1
Typological	-	-	80	1.3	15	13.4	59	93.7	154	2.0
Total import	607	40.3	1,172	19.3	112	-	60	95.2	1,951	25.2
Total n	1,505		6,060		112		63		7,740	
Ware % of import		31.1		60.0		5.8		3.1		-
Ware % of total		19.4		78.3		4.4		0.8		-
A.D. 1040-1100										
Trachyte	595	49.8	368	19.8	-	-	-	-	963	30.7
Chalcedonic SS	76	6.4	33	1.8	-	-	-	-	109	3.5
San Juan	13	1.1	32	1.7	28	82.4	1	1.8	74	2.4
Socorro	-	-	1	0.1	-	-	-	-	1	0.0
Tusayan	-	-	13	0.7	-	-	-	-	13	0.4
Typological	1[a]	0.1	30	1.6	6	17.6	54[b]	94.7	91	2.9
Total import	685	57.4	477	25.7	34	-	55	96.5	1,251	39.8
Total n	1,194		1,855		34		57	-	3,140	
Ware % of import		54.8		38.1		2.7		4.4		-
Ware % of total		38.0		59.1		1.1		1.8		-

Table 2.58. (continued)

	Import									
	Grayware		Whiteware		Redware		Smudged		Overall	
Time/Identification	No.	%	No.	%	No.	%	No.	%	No.	%
A.D. 1100-1200										
Trachyte	165	49.5	194	26.6	-	-	-	-	359	31.3
Chalcedonic SS	11	3.3	3	0.4	-	-	-	-	14	1.2
San Juan	6	1.8	28	3.8	1	1.8	-	-	35	3.0
Socorro	-	-	2	0.3	-	-	-	-	2	0.2
Little Colorado	-	-	3	0.4	-	-	-	-	3	0.3
Tusayan	-	-	55	7.6	-	-	-	-	55	4.8
Typological	2[a]	0.6	13	3.2	54	98.2	32	100.0	111	9.7
Total import	184	55.3	308		55	-	32	-	579	50.4
Total n	333		728		55		32		1,148	-
Ware % of import		31.8		53.2		9.5		5.5		
Ware % of total		29.0		63.4		4.8		2.8		
A.D. 1200-1300										
Trachyte	18	26.1	7	16.3	-	-	-	-	25	21.6
Chalcedonic SS	4	5.8	-	-	-	-	-	-	4	3.4
San Juan	4	5.8	15	34.9	-	-	-	-	19	16.4
Typological	-	-	1	2.3	4	100.0	-	-	5	4.3
Total import	26	37.7	23	53.5	4	-	-	-	53	45.7
Total n	69		43		4		-		116	
Ware % of import		49.1		43.4		7.5		-		-
Ware % of total		59.5		37.1		3.4		-		-
Unplaced items										
Trachyte	71	23.7	153	13.0	6	5.5	-	-	230	13.9
Chalcedonic SS	19	6.4	45	3.8	-	-	-	-	64	3.9
San Juan	3	1.0	40	3.4	49	45.0	-	-	92	5.6
Socorro	-	-	2	0.2	-	-	-	-	2	0.1
Typological	4[a]	1.3	110	9.4	52	47.7	60[b]	81.1	226	13.6
Total import	97	32.4	350	29.8	107	98.2	60	81.1	614	37.1
Total n	299		1,174		109		74		1,656	
Ware % of import		15.8		57.0		17.4		9.8	-	
Ware % of total	-	18.1	-	70.9	-	6.6	-	4.5	-	-
TOTAL IMPORT	1,797		2,644	-	451	-	274	-	5,166	-
TOTAL n	5,297		11,585	-	453		339		17,674	
% of import		33.9		22.8		99.6		80.8		29.2
Ware % of import		34.8		51.2		8.7		5.3		-
Ware % of total		30.0		65.5		2.6		1.9		-

Little Colorado sherds are identified by paste and carbon paint. Some here have no paint present and are identified by paste alone.

[a] All brownware.

[b] Polished smudged with coarse sandstone temper is considered Lino Smudged and treated as possibly local.

some other series (Little Colorado, Tusayan), vessels are not considered imported unless the temper is identified as nonlocal (Toll et al. 1980).

Trends in Ceramic Import

An overview of conservatively estimated ceramic import through time is presented in Table 2.58, which includes sherds from all eleven Chaco project temper-analyzed sites. It is important to realize that some time groups are reflections more of particular sites than of canyon-wide groups.

Entries in the table are calculated to show the following:

1) Percent import columns. The percent of the total number of a given ware in a particular time group that are identifiable imports.

2) Total import rows. Again, the percent of the total ware in a time group that fits this definition of imported.

3) Ware percent of import rows. The n of imported wares is divided by the total n of imports.

4) Ware percent of total. The total n of each ware is divided by the total n of the time period. This is useful for comparing to the ware percent of imports as a sort of expected value.

Even this compromise approach results in some problems of inequality. Some of these are "real" and result from the sites dug; some are hybrids between reality and classification. The most vigorous of these hybrids is the A.D. 800 to 920 group which has probably been shorted on ceramics in general, and whitewares in particular. This is the result of this period having no "default" whiteware type (Table 2.55), only one low frequency grayware type, and the fact that this time segment is a difficult one to specify. The very small size of the final A.D. 1200 to 1300 group is a fairly good reflection of the relative quantity of excavated proveniences from the period. Only part of a two-room test at 29SJ 633 is likely to have dated this late. Here, too, whitewares are disproportionately few.

Based on Table 2.58, Figures 2.11-2.14 show within-ware trends in occurrence of the three most abundant, confidently identifiable nonlocal tempers and the total import. It is quite clear that the relationships of different producing areas with the consumers in Chaco Canyon changed greatly through time. There were indubitably variability and change within each temper group's area. This is especially true within the San Juan temper group, which represents a large area; different parts of areas must have produced different wares or types at different times. For example, Lucius and Breternitz (1981:106-107) and Hegmon et al. (1995) suggest that San Juan Redwares were likely to have been produced in the western portions of the Mesa Verde Region (southeast Utah), while the white and graywares with temper in the same class found in Chaco Canyon are likely be from further east and south. The area of the confluence of the La Plata, Animas, and San Juan Rivers is a likely candidate (the Totah—see McKenna and Toll 1992; Wilson 1993). Variability in clay is also present across time and within Chuskan groups (Toll et al. 1980; Toll and McKenna 1987, 1992; Windes 1977; Zedeño et al. 1993). Thus, the import relationships implied by Table 2.58 and Figures 2.11-2.14 cannot be considered to be between Chaco Canyon and specific producers; rather, they show changing relationships with general areas through time.

Pre-A.D. 800. The main sites containing provenience assignments as distinguished from type assignments from this time group are, in order of contribution, 29SJ 628, 29SJ 724, 29SJ 299, and 29SJ 423. As discussed above, it is the sites with provenience assignments that will contribute all "generic" items such as redwares and plain gray to the totals in Table 2.58. In overall contribution of provenience plus type assignment, there is again, a broad, fairly even distribution among sites: 29SJ 628, 29SJ 423, 29SJ 299, 29SJ 724, 29SJ 627, 29SJ 1360, and 29SJ 629. All of the major temper types are present in this earliest segment, but the groups which are predominant are quite different from those that are high frequency later. The ware percentages show that whitewares are less frequent than in later periods (the white and redware counts may even be somewhat inflated by a bias toward including these infrequent types in the detailed analysis sample). The typological group is heavily weighted by ceramics commonly attributed to eastern Arizona and southern

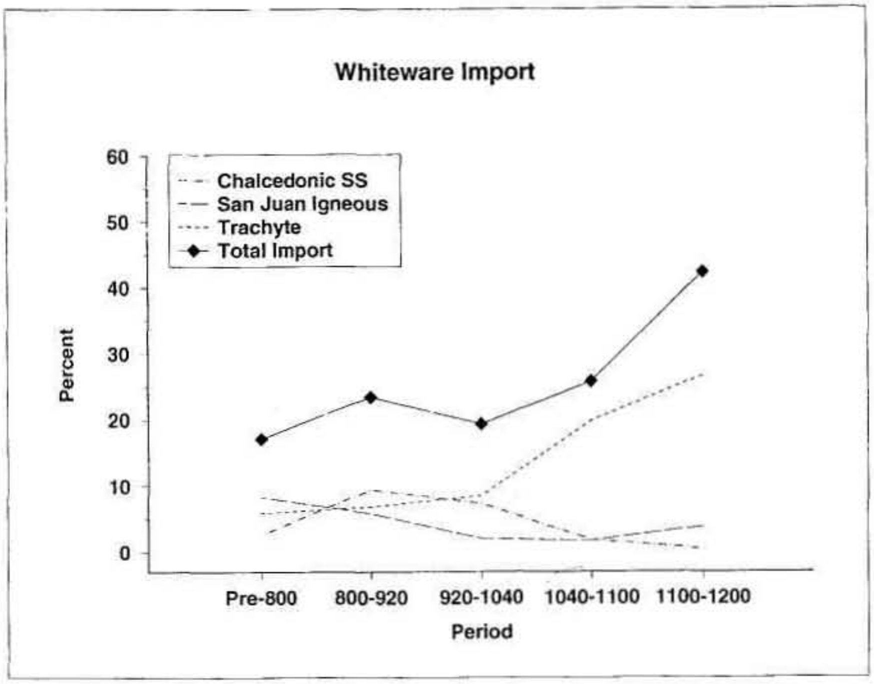


Figure 2.11. Major import temper materials in whitewares found in Chaco Canyon sites by time period. Total import includes typologically identified imports.

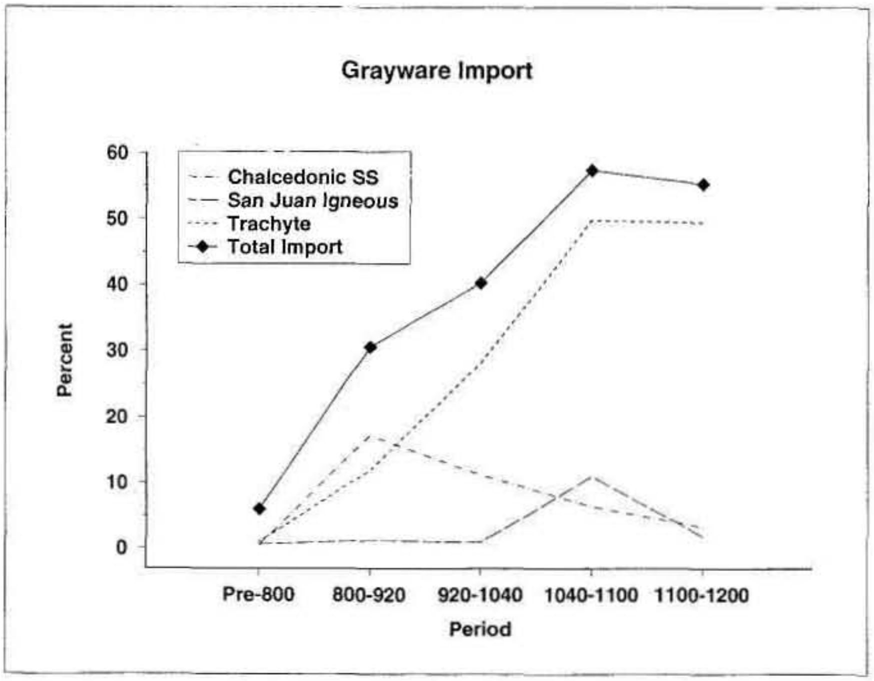


Figure 2.12. Major import temper materials in graywares found in Chaco Canyon sites by time period. Total import includes typologically identified imports. Coarse-grained sandstone tempers are not included here.

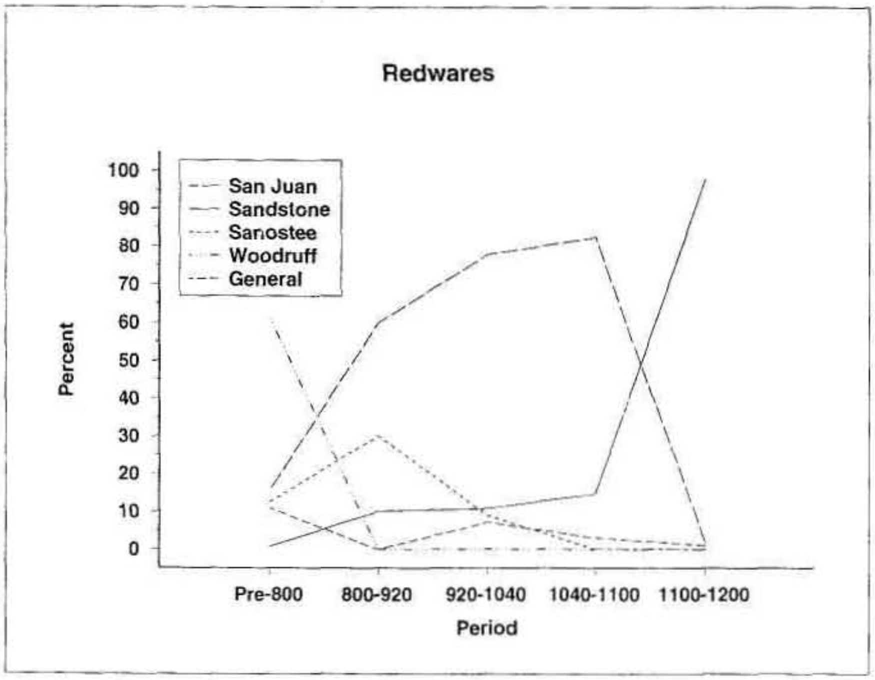


Figure 2.13. Tempering materials in redwares found in Chaco Canyon sites by time period. The sherd and sandstone line combines Tsegi Orangeware and White Mountain Redware in the later periods.

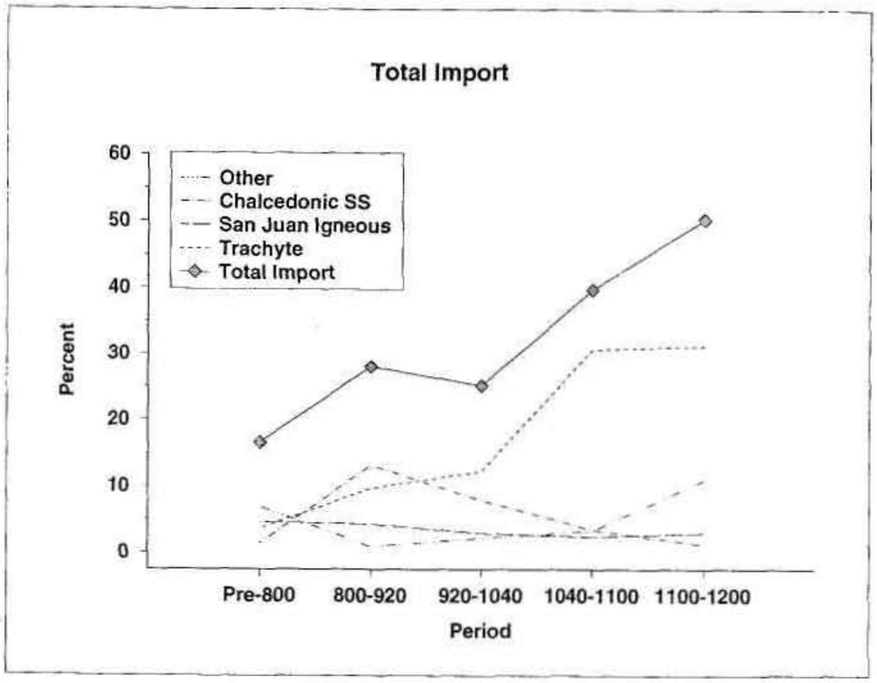


Figure 2.14. Summary of trends in import to Chaco Canyon by time period. Totals of major temper groups and the typological category ("other" on the graph) are from Table 2.61.

New Mexico Mogollon. The early brownwares, redwares, and smudged wares of the Forestdale/Woodruff series (Breternitz 1966:75; Colton and Hargrave 1937:59-60) constitute most of this category. Nearly half of these early red and brown vessels are jar forms, very different from later examples of these wares which consist of three-fourths or more bowls. Redware, other than Woodruff, in the typological identification row in Table 2.58 fits the description for Lino Red. While Lino Red may have been made in the San Juan Basin, perhaps even in Chaco Canyon, the required slip clays do not occur in Chaco Canyon. Lino Red is, therefore, considered nonlocal.

Lino and Woodruff Redwares and Brownwares appear almost exclusively in this period in Chaco Canyon, and most sherds of this type are from 29SJ 423, the earliest site in the analysis. Forestdale Smudged, from the same area, is present in deposits of all periods. Chuskan Redware, made only until ca. A.D. 900, is also present in considerable amounts in this early period. The other noteworthy class of pottery in this early period, and which occurs in high relative frequencies, is decorated whiteware from the San Juan area. Unlike the Woodruff Reds and Browns from the Mogollon area, San Juan Whitewares are present throughout the Chaco record, but for most of it in lower relative frequencies when all sandstone temper is considered potentially local. Almost all graywares are tempered with varieties of sandstone because coarse-grained sandstone is also very common in whitewares in this time period (Table 2.59) and it shows the lowest percentage of imports of all time groups. Nonetheless, this period has the highest relative frequency of San Juan tempers until the last time segment (Figure 2.14).

A.D. 800 to 920. Sites 29SJ 627, 29SJ 629, and 29SJ 1360 are quite evenly represented by sherds from proveniences assigned to this time segment, with type plus provenience placements slightly favoring 29SJ 627. As discussed, this group is unrealistically small and the percentage of graywares is inflated. Still, the establishment of several important trends is visible here. Chalcedonic cement sandstone jumps to its highest overall relative frequency. Trachyte is more than 10 percent of gray, white, and redwares, and San Juan Redware is the most abundant redware. Due to the appearance of chalcedonic sandstone and trachyte, there is an increase from 6 percent to 30 percent in the amount of grayware that is imported.

A.D. 920 to 1040. Over 60 percent of the ceramics with provenience assignments in this segment come from 29SJ 627, with 29SJ 1360, 29SJ 629, and Pueblo Alto providing most of the rest. Abundance of overall placements follow this site ordering closely. This time segment has twice as many items assigned to it as the next largest one, due to large contributions from sites 29SJ 627 (40 percent of the entire analyzed collection of ceramics is from this site), 29SJ 1360 (10 percent) and 29SJ 629 (9 percent); all three sites were most heavily occupied during this period. The extreme importance of trachyte-tempered ceramics is established here; 28 percent of grayware and 8.5 percent of whitewares are Chuskan. The whiteware percentage reflects the fact that the primary carbon-painted whiteware source at this time is the Chuska Valley, in addition to the occurrence of trachyte found in some mineral-painted sherds. The chalcedonic sandstone area remains an important source of both gray and whitewares. Note that the relative frequency of identifiable imported grayware is twice that of the whiteware, but that the whiteware is by now the most common ware. San Juan Redware is nearly 80 percent of the redware, and Lino Smudged, the one possibly locally produced smudged ware, has dropped out almost entirely.

A.D. 1040 to 1100. Sherds in this group represent around 75 percent from Pueblo Alto and 20 percent from 29SJ 627, with nearly all the provenience assignments being from Pueblo Alto. Trachyte is by far the most abundant non-sandstone temper. It is the temper of over half the vessels in the graywares. The 20 percent frequency of trachyte in the whitewares is again both carbon and mineral-on-white, mostly the latter. Chalcedonic sandstone temper is always more common in grayware than white and is considerably more so here. San Juan Redware represents over 80 percent of the redware, while all smudged ware is probably imported. Grayware is nearly 60 percent imported—the highest level on the table—and is the highest imported percentage of all wares in later proveniences. This is the only post-A.D. 920 time segment in which grayware is over

Table 2.59. *Grain size of unidentified sandstone through time for all Chaco Project sites and maximum identifiable import totals from Table 2.58, assuming coarse sandstone is not local.*

	Grayware		Whiteware		Smudged			
Time/SS Grain Size	No.	%	No.	%	No.	%	Total Time No.	Overall Maximum Percent
Pre-A.D. 800								
Fine	9	0.7	34	3.1	32	30.2	75	
Medium	76	6.0	255	23.4	31	29.2	362	
Coarse	754	60.5	665	61.1	29	27.4	1,448	
Very coarse	412	32.6	135	12.4	14	13.2	561	
Total	1,251		1,089		106		2,446	
Total C+VC	1,176	93.2	800	73.5	43	40.6	2,019	
Maximum import	1,272	81.5	1,042	73.5	109	99.1	2,525	79.4
Total n	1,560		1,417		110		3,216	
A.D. 800-920								
Fine	1	0.4	55	25.1	1		57	
Medium	26	11.3	107	48.9	-	-	133	
Coarse	109	47.4	51	23.3	2	-	162	
Very coarse	94	40.9	6	2.7	-	-	100	
Total	230		219		3		452	
Total C+VC	203	88.3	57	26.0	2	-	262	
Maximum import	305	90.5	129	41.9	3	100.0	447	67.9
Total n	337		308		3		658	
A.D. 920-1040								
Fine	6	0.7	1,181	24.9	24	42.9	1,211	
Medium	107	12.1	2,795	58.8	29	51.9	2,931	
Coarse	423	47.9	745	15.7	3	5.4	1,168	
Very coarse	348	39.4	30	0.6	-	-	378	
Total	884		4,751		56		5,688	
Total C+VC	771	87.2	775	16.3	3	5.4	1,515	
Maximum import	1,378	91.6	1,947	32.1	63	100.0	3,497	45.2
Total n	1,505		6,060		63		7,740	
A.D. 1040-1100								
Fine	13	2.6	233	19.3	22	51.2	268	
Medium	47	9.4	651	54.8	19	44.2	717	
Coarse	217	43.4	289	24.4	2	4.6	508	
Very coarse	223	44.6	14	1.2	-	-	237	
Total	500		1,187		43		1,730	
Total C+VC	440	88.0	303	25.5	2	-	745	
Maximum import	1,185	99.2	7804	2.0	57	100.0	1,996	63.6
Total n	1,194		1,855		57		3,140	

Table 2.59. (continued)

	Grayware		Whiteware		Smudged			
Time/SS Grain Size	No.	%	No.	%	No.	%	Total Time No.	Overall Maximum Percent
A.D. 1100-1200								
Fine	2	1.4	122	37.2	14	46.7	138	
Medium	23	15.9	142	43.3	16	53.3	181	
Coarse	50	34.5	61	18.6	-	-	111	
Very coarse	70	46.5	3	0.9	-	-	73	
Total	145		328		30		503	
Total C+VC	120	82.8	64	19.5	-	-	184	
Maximum import	304	91.3	372	51.1	32	100.0	763	66.5
Total n	333		728		32		1,148	
A.D. 1200-1300								
Fine	1	2.3	2	14.3	-	-	3	
Medium	7	16.3	11	78.6	-	-	18	
Coarse	15	34.9	-	-	-	-	15	
Very coarse	20	46.5	1	7.1	-	-	21	
Total	43		14		-		57	
Total C+VC	35	81.4	1	7.1	-	-	36	
Maximum import	61	88.4	24	55.8	-	-	89	76.7
Total n	69		43		-		116	

"Total Time No." column adds in redwares to both "Total" and "Maximum import" rows.
Column percentages are within-ware within-time percentages of sand temper.
"Overall Maximum Percent" is the sum of all coarse to very coarse sand tempers and all identifiable imports (Table 2.58) divided by the total n of ware or time period.

half of the total import. As will be discussed, the Pueblo Alto Trash Mound has a great deal to do with these apparent anomalies.

A.D. 1100 to 1200. Site contributions to this time group are similar to those for the preceding period: 71 percent from Pueblo Alto, and 21 percent from 29SJ 627. Pueblo Alto is the only site with proveniences placed in this time segment. Trachyte remains the dominant temper, reaching its highest frequency in whitewares. San Juan Redware has all but disappeared, but small increases are apparent in white and graywares from the north. San Juan Redware is replaced by Arizona redwares, specifically Tsegi Orangewares from northeastern Arizona and White Mountain Redwares from east-central Arizona and west-central New Mexico (Table 2.53). Chalcedonic cement sandstone temper has further declined, being found almost entirely in grayware. The increase visible in the typological category of the whiteware import is largely due to the somewhat inflated presence of Tusayan Carbon-on-white, also from northeastern Arizona (see above). As noted, this period is characterized by a dramatic increase in the occurrence of carbon paint on whiteware in Chaco Canyon. Because of primary reliance on temper to determine import within the carbon group (excluding Tusayan), there is possibly some underrepresentation in this time segment. Nonetheless, the whitewares do show a considerable increase in import percent from the previous period.

Post-A.D. 1200. Because of its small size, information on this group can only be considered suggestive. Most of the sherds come from 29SJ 633 and 29SJ 627, with provenience placements only from 29SJ 633; however, some major changes are indeed suggested. There are major increases in San Juan temper in both gray and, especially, whitewares accompanied by a decline in trachyte occurrence. These ceramic shifts seem to reflect the large changes in Chaco Canyon at this time, including reduced population and social reorganization; they probably are also related to the winding down of the Chuska Valley occupation (Toll et al. 1980; Wiseman 1982).

In summary, pottery from source areas waxed and waned through time (Figures 2.11-2.14). San Juan tempers are present throughout the sequence but increased in relative abundance very early and very late. The probable southern chalcedonic sandstone area is predominantly a grayware supplier with greatest importance from A.D. 800 to 1040, with declining but continuous contributions subsequently. Trachyte-tempered ceramics increase rapidly beginning sometime in the A.D. 800s, and the Chuska area becomes not only the main source for grayware from A.D. 1040 to 1200, but also an important supplier of whiteware. To a lesser degree than the San Juan area, Northeastern Arizona and the New Mexico-Arizona boundary also supplied ceramics to Chaco Canyon through time. Ceramics from this large conglomeration of subareas include brownwares and some whitewares very early, polished-smudged wares throughout, whitewares right around A.D. 1100, and the primary redwares after about A.D. 1050 or 1075.

More Liberal Estimates: The Sandstone Aspect

Although we have emphasized the nonlocal tempers and wares to sketch a picture of shifting ceramic supply, most ceramics of most periods in Chaco are sandstone-tempered. The nonlocal picture suggests that complexity is likely for this larger group as well. Variability in sandstone temper can be adumbrated through an examination of sandstone grain size.

Warren's (1976, 1977) assumption that all coarse-grained sandstone seen in pottery is nonlocal has been mentioned and some reservations expressed. It is likely, however, that much coarse sand-tempered pottery found in Chaco Canyon was not made there. By considering such tempers to signify non-canyon pottery, a different sort of import estimate is generated (Table 2.59). This estimate is a maximum of sorts, but still not a true maximum (after all, none of the figures reach 100 percent). Were all mixes of more-sandstone-than-trachyte and all occurrences of unidentified igneous considered imports, the whiteware import percentages in later time segments would be substantially raised. Further, among the fine-grained quartz with sherd-tempered vessels, there are those that must have been produced over 30 km from Chaco Canyon. Because the grain-size treatment is likely to include some "local" pots as imports, there is some balance. The "maxima" generated are, therefore, in terms of what can be estimated from the information at hand.

With the grain-size assumption in effect (Table 2.59), nearly all of each time period's grayware shows as imported. The assumption has considerably less effect on the whiteware of the post-A.D. 900 periods, raising the import estimate less than 10 percent in the earlier and later periods but about 15 percent in the A.D. 1040 to 1100 group. In the earlier groups, however, the whiteware percentages jump radically because of the predominance of coarse grains in the sandstone-tempered vessels of all wares. The facts—that the early period is when pottery scrapers and polishers have been found and the identifiable imports suggest a lower import rate in that period—cast further doubt on the grain-size assumption, especially early. After the low frequency of coarse tempers in whitewares in the A.D. 920 to 1040 period, the increased frequency in A.D. 1040 to 1100 may mean that a new production group or area is represented during this one period.

Under this coarse-sandstone assumption, there is only one period which indicates having more than half "local" pottery. Subjectively, this import level seems high; but we are not in a position to verify or reject it. If nothing more, the occurrence of coarse-grained tempers shows an energy investment to obtain tempers meeting some specification, particularly for graywares. What these conservative (Table 2.58) and probably overstated (Table 2.59) figures do show is a lower limit, one possibility of how much pottery may have been moved some distance, and a clear impression of the fact that external ceramic supply was dynamic, complex, and considerable.

Site Group Comparisons

The relationship between the greathouses and

Table 2.60. Converted estimates of trachyte-sand mixed tempers.

Time Segment	Pueblo Alto %	29SJ 627 No.	Corrected 29SJ 627 No.	Change
A.D. 920-1040	0.377	213	80.3	-133
A.D. 1040-1100	0.465	56	26.0	- 30
A.D. 1100-1200	0.555	18	10.0	- 8

the small sites has long been a focal question in Chaco Canyon. To pursue that question in the context of ceramic import, import information in the same format as the project-wide information above has been assembled for the one extensively tested greathouse, Pueblo Alto, and for a group of at least partially contemporaneous small sites.

As noted in the Temper Section, there were some differences in recording of trachyte mixes at various sites. Using frequencies from Pueblo Alto, it is possible to estimate the number of sherds from 29SJ 627 that would have been removed from import status, had the quantity of sandstone relative to trachyte been analyzed for 29SJ 627. In the figures above, the number of whiteware items recorded at Pueblo Alto as containing more-trachyte-than-sand has been divided by the total number of all whiteware sherds tempered with trachyte-sand mixes. The percentage thus derived, multiplied by the frequency of trachyte-sand mixes from 29SJ 627, gives an estimate of the number that contained more-sand-than-trachyte (Table 2.60). As will be evident below, distributions are consistently similar enough between Pueblo Alto and the other sites that this is a reasonable procedure. Corrections are unnecessary in the grayware counts because mixes with more-sand-than-trachyte are very rare in the graywares.

Many of the trends present in Table 2.61 have been outlined above. In the overall sample, the Pueblo Alto collection dominates the A.D. 1040 to 1100 and A.D. 1100 to 1200 groups. In the graywares and the whitewares and, consequently, in the overall counts, trachyte is the most abundant import temper in all three periods. Considerably less abundant but second in occurrence is chalcedonic sandstone, which shows an overall decline in frequency, counterposing the increase in trachyte. Comparing the Pueblo Alto A.D. 920 to 1040 group with the large sample from the small sites (Table 2.62), the trachyte percentage of the grayware is considerably higher at Pueblo Alto than it is in the small site group (43.2 percent versus 25.7 percent), while chalcedonic sandstone is lower at Pueblo Alto (6.5 percent versus 12.0 percent). This difference is unquestionably due, in part, to the fact that Pueblo Alto was occupied only at the end of the time segment (e.g., A.D. 1000 to 1040), while the other collection spans it. This is especially evident in the chalcedonic sandstone occurrence in the small site group because this temper seems to be most common early (Table 2.62; see also Table 2.57). The extent to which the difference in trachyte occurrence is temporal and to which it is functional cannot be determined, but it is clear that the Chuska connection is strong from early in Pueblo Alto's history. Regarding trachyte-tempered whiteware, the difference between Pueblo Alto and the other sites is less, but the 29SJ 627 sherds inflate the trachyte count by inclusion of all trachyte-sandstone mixes in the import category. Using the "corrected" 29SJ 627 percentage, the frequency of trachyte-tempered items from small sites that would be considered imports falls from 8.3 percent to 5.9 percent of the whiteware, as compared to 10.9 percent at Pueblo Alto (Tables 2.61 and 2.62). Thus, it is fairly certain that the whitewares at Pueblo Alto also contain distinctly more trachyte in this time group than do the other sites.

The A.D. 1040 to 1100 segment spans most of the Pueblo Alto Trash Mound and contains well over half of the temporally placed sample from Pueblo Alto. Several things are noteworthy about this group. Trachyte is the temper of 55 percent of the graywares and grayware becomes most abundant, relative to other wares. The ware distributions at the small sites is remarkably similar, although the percentage of trachyte-tempered grayware is again less (37 percent). The occurrence of trachyte in whitewares

Table 2.61. *Summary of identifiable ceramic imports through time at Pueblo Alto.*

	Import									
	Grayware		Whiteware		Redware		Smudged		Overall	
Time/Identification	No.	%	No.	%	No.	%	No.	%	No.	%
A.D. 920-1040										
Trachyte	80	43.2	47	10.9	-	-	-	-	127	20.0
Chalcedonic SS	12	6.5	22	5.1	-	-	-	-	34	5.3
San Juan	-	-	6	1.4	6	-	-	-	12	1.9
Socorro	-	-	1	0.2	-	-	-	-	1	0.2
Typological	-	-	6	1.4	1	-	12	92.3	19	3.0
Total import	92	49.7	82	19.0	7	-	12	92.3	193	30.3
Total n	185		431		7		13		636	
Ware % of import	47.7		42.5		3.6		6.2			
Ware % of total	29.1		67.8		1.1		2.0			
A.D. 1040-1100										
Trachyte	470	55.2	254	19.5	-	-	-	-	724	32.3
Chalcedonic SS	56	6.6	20	2.2	-	-	-	-	84	3.8
San Juan	9	1.1	25	1.9	27	84.4	-	-	61	2.7
Socorro	-	-	1	0.1	-	-	-	-	1	0.0
Tusayan	-	-	13	1.0	-	-	-	-	13	0.6
Typological	1[a]	0.1	28	2.2	5	15.6	52	96.3	86	3.8
Total import	536	62.9	349	26.8	32	-	52	96.3	969	43.3
Total n	852		1,301		32		54		2,239	
Ware % of import		55.3		36.0		3.3		5.4		
Ware % of total		38.1		58.1		1.4		2.4		
A.D. 1100-1200										
Trachyte	121	53.8	141	27.8	-	-	-	-	262	32.0
Chalcedonic SS	8	3.6	3	0.6	-	-	-	-	11	1.3
San Juan	5	2.2	14	2.8	1	1.8	-	-	20	2.4
Socorro	-	-	2	0.4	-	-	-	-	2	0.2
Little Colorado	-	-	2	0.4	-	-	-	-	2	0.2
Tusayan	-	-	13	2.6	-	-	-	-	13	1.6
Typological	2[a]	0.9	33	6.5	54	98.2	32	100.0	121	14.8
Total import	136	60.4	208	40.8	55	-	32	-	431	52.6
Total n	225		508		55		32		820	
Ware % of import		31.6		48.3		12.8		7.4		
Ware % of total		27.4		62.0		6.7		3.9		
Unplaced items										
Trachyte	29	42.0	8	20.0	-	-	-	-	37	30.8
Chalcedonic SS	2	2.9	-	-	-	-	-	-	2	1.7
San Juan	-	-	1	2.5	2	-	-	-	3	2.5
Socorro	-	-	1	2.5	-	-	-	-	1	0.8
Typological	-	-	10	25.0	7	-	-	2	19	15.0
Total import	31	44.9	20	50.0	9	-	2	-	62	50.8
Total n	69		40		9		2		120	
Ware % of import		50.0		32.3		14.5		3.2		
Ware % of total		57.5		33.3		7.5		1.7		

Table 2.61. (continued)

	Import									
	Grayware		Whiteware		Redware		Smudged		Overall	
Time/Identification	No.	%	No.	%	No.	%	No.	%	No.	%
GRAND TOTAL										
Import	795		659		103		98	-	1,655	-
Total n	1,331		2,2805		103		101		3,815	
% of import		59.7		28.9		100.0		97.0		43.4
Ware % of import		48.0		39.8		6.2		5.9		
Ware % of total		34.9		9.8		2.7		2.6		

4 "mudwares" are not shown.

[a] typologically identified "grayware" imports are brownwares.

is 20 percent at both Pueblo Alto and the small sites; but with the correction estimate for the 29SJ 627 contribution, the smaller sites' whiteware trachyte percentage falls to 15 percent. While there is more chalcedonic sandstone in small site whitewares, both Pueblo Alto and the other sites show 6.7 percent chalcedonic sandstone in the graywares. Most of the San Juan temper occurring at Pueblo Alto in this segment is found in the redwares, which are predominantly San Juan. While all 42 Tusayan Whiteware specimens from the small sites are placed in the A.D. 1100 to 1200 segment by default, the 26 from Pueblo Alto are split evenly between A.D. 1040 to 1100 and A.D. 1100 to 1200. If the small site Tusayan Whitewares are similarly split (another reasonable correction), the whiteware import figure would be 26-27 percent at both Pueblo Alto and the small sites. With the trachyte and the Tusayan corrections, the small-site grayware and whiteware import percentages remain somewhat below those for Pueblo Alto, although the import composition is very similar in the two groups.

The final time segment (A.D. 1100 to 1200+) runs later at the small sites because of the presence of 29SJ 633 and, perhaps, even residual use of 29SJ 627 (Mesa Verde Black-on-white occurs in a very small quantity at 29SJ 627). The whiteware import at the small sites is very high, but with the two correction estimates in effect, it is again within a point of Pueblo Alto's. Presumably because of the later component at the small sites, the San Juan percentage is considerably higher than it is at Pueblo Alto, but the pattern of very similarly distributed, slightly lower level import at the small sites is repeated.

The occupation of Pueblo Alto spans a prolonged period during which the frequencies of San Juan Whitewares and Graywares are apparently at their lowest in Chaco Canyon, and sees the termination of San Juan Redware. Pueblo Alto's postulated northern orientation, based on site location and the direction of roads converging there, is not apparent in the ceramics in temper or type, at least if "north" means San Juan. Quite the reverse is true; lower than overall frequencies are found in whitewares, grayware percentages in the same low range are not seen until very late, and either heirloomed or very late redwares are seen in a period notable for its low redware frequency. In the terminal deposits at Pueblo Alto, there is a slight upturn in gray and whiteware frequencies with San Juan temper, but it only faintly foreshadows the higher frequencies seen post-A.D. 1200 (Table 2.57; Toll et al. 1980).

Instead of northern tempers, two others predominate. Comparisons of Pueblo Alto with other sites (Toll 1981, 1984) have indicated that the temper composition at Pueblo Alto is more diverse and more evenly distributed than it is at other sites. This result stems from having at least two major tempers which are well represented—sandstone and trachyte—instead of the heavy dominance by sandstone that characterizes the small sites. Table 2.63 considers only the imported component as shown in Tables 2.61 and 2.62; however, it provides an important

Table 2.62. *Summary of identifiable ceramic imports through time from Chaco Project small sites (29SJ 627, 29SJ 629, 29SJ 1360, and 29SJ 633).*

	Import									
	Grayware		Whiteware		Redware		Smudged		Overall	
Time/Identification	No.	%	No.	%	No.	%	No.	%	No.	%
Pre-A.D. 920										
Trachyte	45	8.3	95	12.0	4	33.3	-	-	144	10.7
Chalcedonic SS	59	10.9	58	7.3	-	-	-	-	117	8.7
San Juan	6	1.1	45	5.7	7	58.3	-	-	58	4.3
Typological	-	-	6	0.8	1	8.3	1	-	8	0.6
Total import	110	20.4	204	25.8	12	100.0	1	-	327	24.2
Total n	540		791		12		6		1,349	
Ware % of import		33.6		62.4		3.7		0.3		-
Ware % of total		40.0		58.6		0.9		0.4		-
A.D. 920-1040										
Trachyte	330	25.7	461	8.3	10	9.6	-	-	801	11.4
Chalcedonic SS	154	12.0	421	7.6	-	-	1	2.0	576	8.2
San Juan	10	0.8	112	2.0	80	76.9	-	-	202	2.9
Socorro	-	-	3	0.1	-	-	-	-	3	-
Little Colorado	-	-	4	0.1	-	-	-	-	4	0.1
Typological	-	-	62	1.1	14	13.5	47	94.0	123	1.8
Total import	494	38.5	1,063	19.1	104	100.0	48	96.0	1,709	24.4
Total n	1,284		5,574		104		50		7,012	
Ware % of import		28.9		62.2		6.1		2.8		-
Ware % of total		18.3		79.5		1.5		0.7		-
A.D. 1040-1100										
Trachyte	124	36.7	111	20.4	-	-	-	-	235	26.6
Chalcedonic SS	19	5.6	5	0.9	-	-	-	-	24	2.7
San Juan	4	1.2	7	1.3	1	-	-	-	12	1.4
Typological	-	-	2	0.4	1	-	-	-	3	0.3
Total import	147	43.5	125	23.0	2	-	-	-	274	31.0
Total n	338		543		2		-		883	
Ware % of import		53.6		45.6		0.7		-		-
Ware % of total		38.3		61.5		0.2		-		-
Post A.D. 1100										
Trachyte	62	36.5	56	22.4	-	-	-	-	118	27.8
Chalcedonic SS	7	4.1	-	-	-	-	-	-	7	1.7
San Juan	4	2.4	28	11.2	-	-	-	-	32	7.5
Little Colorado	-	-	1	0.4	-	-	-	-	1	0.2
Tusayan	-	-	41	16.4	-	-	-	-	41	9.7
Typological	-	-	1	0.4	4	-	-	-	5	1.2
Total import	73	42.9	127	50.8	4	-	-	-	204	48.1
Total n	170		250		4		-		424	
Ware % of import		35.8		62.3		2.0		-		-
Ware % of total		40.1		59.0		0.9		-		-

Table 2.63. Shannon-Weaver diversity and evenness of import types by site-time group.

Time/Site	Import No.	Diversity H'	Evenness J	Import Categories s	Total Import %
A.D. 920-1040					
29SJ 629	219	1.974	.769	13	21.6
29SJ 1360	393[a]	1.802	.752	11	34.1
29SJ 627	1,037	1.821	.759	11	22.2
29SJ 627 corrected	904	1.920	.801	11	19.3
Pueblo Alto	193	1.680	.730	10	30.3
Small Sites	1,709	1.894	.739	13	24.4
A.D. 1040-1100					
29SJ 627[b]	194	1.049	.585	6	28.3
29SJ 627 corrected[b]	164	1.097	.612	6	23.9
Pueblo Alto	969	1.539	.619	12	43.3
Small Sites[b]	274	1.785	.812	9	31.0
A.D. 1100-1200					
Pueblo Alto	431	1.756	.706	12	52.6
29SJ 627[b]	135	1.365	.762	6	50.9
Small Sites[b]	274	1.215	.553	9	31.0
A.D. 1200+					
29SJ 633[b]	29	1.587	.816	7	53.7

Small site totals do not use 29SJ 627 sand-trachyte correction.

[a] McKenna and Toll (1984:207) contains an arithmetic error of 10 and a 2-sherd temporal adjustment has been made.

[b] Sample size and/or lack of provenience placements make these time-site units inequivalent to the others. They are included only to show trends.

The Shannon Weaver diversity index is discussed briefly in Appendix 2D.

qualifier for the comparison. Table 2.63 treats each ware on the typological row and each temper-ware combination as a category (e.g., trachyte-tempered whiteware, San Juan-tempered Redware, and polished smudged are each considered a separate category). Tusayan and Little Colorado Whitewares, though shown separately on the tables, are included in the typological frequencies. In this comparison of the time-site groups with full provenience placements and substantial samples, the A.D. 1040 to 1100 sample from Pueblo Alto is the least diverse in import of the three time segments. Pueblo Alto is also the least diverse site in the A.D. 920 to 1040 segment. In fact, the period of the most intense activity at Pueblo Alto has the lowest indices of any time-site group from A.D. 920 to 1200 containing an adequate sample (Table 2.63). From A.D. 1040 to A.D. 1100, trachyte is the predominant temper in carbon-on-white and graywares and reaches its highest frequencies in the mineral-on-white types (Figure 2.9). The final period (A.D. 1100 to A.D. 1200) is the most diversely and evenly distributed at Pueblo Alto because of the large numbers in each of the typological ware groups. The indices in Table 2.63 summarize import to Pueblo Alto from A.D. 940 to 1100 quite nicely. There is a high volume of recognizable imports from a particular region which is expressed as low relative diversity, low evenness, and high overall import percentage. While there is definitely variability within trachyte-tempered ceramics (in paint types, clays and designs), on the whole, there is consistency that suggests areal production and reliance on the Chuska area by Chaco Canyon was heavy. The predominance of trachyte imports should not be allowed to overshadow the fact that in overall supply, Pueblo Alto does indicate more diversity because, again, the amounts of sandstone temper and trachyte temper are more nearly equal than is true anywhere else.

Though the confidently identifiable imports for the period of maximum activity at Pueblo Alto show low diversity, there is some indication of increased diversity in sandstone tempers. As discussed, there is an increase in coarse sandstone temper in whitewares in the general counts in the A.D. 1040 to 1100 group (Table 2.59). This is apparent in Tables 2.64 and 2.65, which are constructed with the same procedures and assumptions as the grain-size table (Table 2.59). At Pueblo Alto, the occurrence of coarse sandstone in whiteware can be seen to jump from 8.5 percent to 23.3 percent from the A.D. 920 to 1040 to the A.D. 1040 to 1100 time segments (16.8 percent to 28.9 percent at the small sites). Assuming coarse sandstone to be nonlocal (see Temper Section), the "maximum" level of whiteware import to Pueblo Alto rises from 25.1 percent in the initial period to 40.7 percent in the A.D. 940 to 1100 segment (Table 2.64). The increase is less dramatic at the small sites (32.4 percent to 44.8 percent [39.2 percent corrected for mixes] Table 2.65). Some of the greater percentage of coarse temper at the small sites is, again, probably due to the presence of earlier sherds at those sites in the A.D. 920 to 1040 period. Still, coarse-grained sandstone remains higher at the small sites in the A.D. 1040 to 1100 segment (28.9 percent versus 23.3 percent of sandstone temper), suggesting a somewhat broader supply base for Pueblo Alto than the small sites. The differences in grain size between Pueblo Alto and the small sites are significant (at $p<.05$) in both pre-A.D. 1100 segments. Sandstone grain-size distributions in the last period are remarkably similar.

Coarse sandstone temper is found in both Gallup and Puerco Black-on-white in quantities greater than that found in Red Mesa Black-on-white (21 percent versus 6 percent at Pueblo Alto), and well over half (57 percent) of sandstone-tempered Escavada Black-on-white is coarse-grained. The relative frequency of coarse sandstone in whiteware and grayware drops somewhat in the final period at Pueblo Alto and the small sites, although the whiteware percentage is still higher than it is in the A.D. 920 to 1040 segment. It seems reasonable to suggest that the coarse-grained sandstone-tempered whiteware group may represent a production area. If this were the case, the low diversity in imports, due to the reliance on trachyte-tempering potters, is counterbalanced by an additional sandstone tradition. There is an increase in the relative frequency of Escavada Black-on-white in the deposits immediately after the cessation of trash mound deposition, which is the time for which a perturbation in ceramic supply has been suggested. It may be further suggested, then, that this ripple stimulated a brief period of added import of these less carefully-made vessels as a part of the readjustment taking place.

The sandstone grain size in graywares is, as in all time periods and in all tempers, heavily weighted to the coarse. The highest "maximum" import level reached at Pueblo Alto is in the A.D. 1040 to 1100 group, because of the high trachyte levels and continued high coarse-grained sandstone levels. There is an additional suggestion of a shift in A.D. 1100 to 1200, superficially in the opposite direction from the whiteware trend. That is, the fine and medium grain-size percentages increase substantially in this last period. This change goes along with the increased appearance of sherd temper in graywares (Figure 2.2A). This change may be temporal or it may relate to supply area; perhaps more grayware pots were made locally in the last period. In any case, this change in graywares may be added to the list of substantial changes in ceramics in this period of flux.

Pueblo Alto-Small Site Comparisons

How Pueblo Alto compares to small sites in import and vessel form assemblage is of much general interest because of the many speculations on the significance of the "town-village" (greathouse-small house) split. A problem that has significance for far more than ceramics is the project sample's lack of fully contemporaneous small site and large-site deposits. The reader should be aware that there is some argument over the actual existence of small sites that were truly contemporaneous with the greathouses. Small sites with ceramic assemblages precisely corresponding to the greathouse trash mounds are rare (Windes and Doleman 1985), and it may be that many sites now considered contemporary in fact pre- or post-dated the A.D. 1050 to 1100 greathouses, a point of considerable contention (Truell 1986). With the present use of typological dates, some contemporaneity must be assumed.

In the Chaco Project assemblage, the site that comes close to temporally overlapping Pueblo Alto is 29SJ 627. The heaviest use of 29SJ 627 antedates the heaviest use of Pueblo Alto, but the ceramic types

Table 2.64 *Grain size of unidentified sandstone through time at Pueblo Alto, and maximum identifiable import totals from Table 2.61, assuming coarse sandstone is not local.*

	Grayware		Whiteware		Smudged			Overall
Time/SS Grain Size	No.	%	No.	%	No.	%	Total Time No.	Maximum Percent
A.D. 920-1040								
Fine	-	-	80	26.1	6	50.0	86	
Medium	9	9.9	200	65.4	5	41.7	214	
Coarse	49	53.8	26	8.5	1	8.3	76	
Very coarse	33	36.3	-	-	-	-	33	
Total	91		306		12		409	
Total C+VC	82	90.1	26	8.5	1	8.3	109	
Maximum import	174	94.1	108	25.1	13	100.0	302	47.5
Total n	185		431		13		636	
A.D. 1040-1100								
Fine	5	1.6	143	18.6	22	53.4	170	
Medium	20	6.4	448	58.1	17	41.5	485	
Coarse	145	46.6	173	22.4	2	4.9	320	
Very coarse	141	45.3	7	0.9	-	-	148	
Total	311		771		41		1,133	
Total C+VC	286	92.0	180	23.3	2	4.9	468	
Maximum import	822	96.5	529	40.7	54	100.0	1,437	64.2
Total n	852		1,301		54		2,239	
A.D. 1100-1200								
Fine	1	1.2	82	36.0	14	46.7	97	
Medium	16	18.4	104	45.6	16	53.3	136	
Coarse	33	37.9	40	17.5	-	-	73	
Very coarse	37	42.5	2	0.9	-	-	39	
Total	87		228		30		345	
Total C+VC	70	80.5	42	18.4	-	-	112	
Maximum import	206	91.6	250	49.2	32	100.0	543	66.2
Total n	225		508		32		820	

"Total Time No." column adds redwares to both "Total" and "Maximum import" rows.
Column percents are within-ware within-time percentages of sand temper.
"Overall Maximum Percent" is the sum of all coarse to very coarse sand tempers and all identifiable imports (Table 2.61) divided by the total n of ware or time period.

Table 2.65. *Small site unidentified sandstone grain size through time and import totals assuming coarse sandstone is not local. Coarse sandstone is summed with totals in Table 2.62.*

	Grayware		Whiteware		Smudged		Total	Overall Maximum
Time/SS Grain Size	No.	%	No.	%	No.	%	Time No.	Percent
Pre-A.D. 920								
Fine	1	0.2	80	14.2	1	-	82	
Medium	34	8.3	230	40.9	-	-	264	
Coarse	202	49.0	196	34.9	3	-	401	
Very Coarse	175	42.5	56	10.0	2	-	233	
Total	412		562		6		980	
Total C+VC	377	91.5	252	44.8	5	-	634	
Maximum import	487	90.2	456	57.6	6	-	961	71.2
Total n	540		791		6		1,349	
A.D. 920-1040								
Fine	6	0.8	1,092	24.8	18	40.9	1,116	
Medium	95	12.2	2,576	58.4	24	54.5	2,695	
Coarse	369	47.4	713	16.2	2	4.5	1,084	
Very coarse	309	39.7	30	0.7	-	-	339	
Total	779		4,410		44		5,234	
Total C+VC	678	87.0	743	16.8	2	4.5	1,423	
Maximum import	1,172	91.3	1,806	32.4	50	100.0	3,132	44.7
Total n	1,284		5,574		50		7,012	
A.D. 1040-1100								
Fine	8	4.3	89	21.8	-	-	97	
Medium	27	14.5	202	49.4	-	-	229	
Coarse	69	37.1	111	27.1	-	-	180	
Very coarse	82	44.1	7	1.7	-	-	89	
Total	186		409		-		595	
Total C+VC	151	81.2	118	28.9	-	-	269	
Maximum import	298	88.2	243	44.8	-	-	543	61.5
Total n	338		543		-		883	
Post A.D. 1100								
Fine	2	2.1	41	38.7	-	-	43	
Medium	13	13.7	44	41.5	-	-	57	
Coarse	32	33.7	19	17.9	-	-	51	
Very coarse	48	50.5	2	1.9	-	-	50	
Total	95		106		-		201	
Total C+VC	80	84.2	21	18.9	-	-	101	
Maximum import	153	90.2	148	59.2	-	-	305	71.9
Total n	170		250		-		424	

"Total Time No." column adds redwares to both "Total" and "Maximum import" rows.

Column percents are within-ware, within-time percentages of sand temper.

"Overall Maximum Percent" is the sum of all coarse to very coarse sand tempers and all identifiable imports (Table 2.62) divided by the total n of ware or time period.

found at 29SJ 627 indicate that something was going on at 29SJ 627 for much of the Pueblo Alto occupation. While the predominant decorated types are Red Mesa Black-on-white in the 29SJ 627 ceramic collection and Gallup Black-on-white at Pueblo Alto, the second most abundant decorated types at these two sites are Gallup and Red Mesa Black-on-white, respectively. The most abundant grayware type at both sites is Pueblo II Corrugated. Moreover, several later types such as Tusayan Whiteware, Pueblo III Corrugated and Mesa Verde Black-on-white occur at both sites in small percentages. The earlier emphasis is clear in the ceramics at 29SJ 627 and the later in Pueblo Alto. Site 29SJ 633 also overlaps with Pueblo Alto, but tends to be later. The period with the best nominal overlap is A.D. 920 to 1040, from which 29SJ 629, 29SJ 1360, 29SJ 627, and Pueblo Alto all have sizable ceramic representation (Tables 2.63 and 2.66). The three smaller sites were probably occupied for all of the period, while the occupation of Pueblo Alto was weighted toward the end of the period.

Table 2.66 presents summary results for each site, calculated as were the import tables presented thus far (Tables 2.57, 2.59, 2.61, 2.62, 2.64, and 2.65). Unfortunately, comparisons during the critical A.D. 1040 to 1100 period are hampered by the lack of deposits assigned specifically to this time period at 29SJ 627; although there are large numbers of grayware and whiteware sherds assigned typologically, there are no red or smudged wares placed by provenience. Therefore, consideration of Table 2.66 will concern only grayware and whiteware for each site-time group, as shown in the two left-hand columns. Red and smudged ware data are shown where available but are not included in the overall import percentages or maxima. The most striking thing about this table is the overall similarity from site to site. With only a slight tendency to higher levels of grayware import, Pueblo Alto seems to fit well in the trend visible in smaller sites. When the weighting toward later ceramics is considered in combination with the canyon trend, even the higher grayware import percentage may be more time than site related. Comparing only site-time groups with large samples and full treatment, Pueblo Alto does stand out for its grayware frequency and grayware import percentages, especially in the A.D. 1040 to 1100 time segment, as would be predicted from internal site findings. Apparent anomalies are present. The grayware percentage in pre-A.D. 920 at 29SJ 627 and the whiteware import levels for 29SJ 1360 in A.D. 920 to 1040 are high. The high percentage for A.D. 920 to 1040 at 29SJ 1360 results from higher than usual occurrences of both chalcedonic sandstone and San Juan igneous, which may be, in part, the result of a slightly different set of identification criteria applied to the 29SJ 1360 temper (i.e., a different analyst did the sherds (Temper Section). This explanation is, however, unlikely to account for all of 29SJ 1360's higher import frequency. There are some circumstantial suggestions that 29SJ 1360 is more likely to have been a manufacturing site and the higher import level seems in some senses inconsistent with pottery production. Increased contact with other potters, emphasis of certain wares or forms at 29SJ 1360, and fuel supply problems may all have contributed to this occurrence (see Production section; McKenna and Toll 1984: 206).

There is a tendency for small groups of sherds from terminal periods at sites to show sharp increases in import percentages. For example, 29SJ 1360 and 29SJ 629 gray and whiteware in A.D. 1040 to 1100 have this tendency (Toll 1984) as does 29SJ 627 whiteware in A.D. 1100 to 1200 (Table 2.66). This may be due to the effects of typological time-segment replacement, but it may also be that circumstances leading to site abandonment might have disrupted procurement and/or production of pottery at a site.

The "maximum" estimates (Table 2.66) have a remarkably smooth aspect. Within each time group of adequate size, the sites fall within ten percentage points, except for the pre-A.D. 920 and A.D. 1100 to 1200 segments at 29SJ 627. The high grayware percentage in early 29SJ 627 drives up the site's maximum import figure, and the inclusion of all trachyte mixes inflates its A.D. 1100 to 1200 whiteware import percentage.

In summary, the reliance on identifiably imported ceramics increases at all sites through time. Of the site-time groups with substantial n's that can be confidently monitored, Pueblo Alto shows the highest percentages of imports, but the higher percentages may be at least partly because the Pueblo Alto materials are, on the whole, later. The diversity

Table 2.66. *Comparison of percentages of import from five Chaco Canyon sites through time. "Conservative" percentages are calculated from identifiable nonlocal tempers and types; "maximum" percentages add coarse-grained sandstone tempers to the conservative figures.*

				Conservative Import Estimates					
Period/Site	Total No.	Grayware %	Whiteware %	Grayware Import %	Whitware Import %	Redware %	Smudged %	Grayware and Whiteware Import %	Maximum Overall %
Pre A.D. 920									
Early sites	2,496	53.5	37.1	6.2	11.5	5.1	4.3	8.4	80.8
29SJ 629	341	22.3	76.2	18.4	29.2	0.9	0.6	26.8	67.7
29SJ 1360	355	39.2	58.9	22.3	31.1	0.8	1.1	27.6	68.7
29SJ 627	649	49.8	48.7	20.1	19.1	0.9	-	20.0	74.0
Small	1,349	49.0	58.6	20.4	25.8	0.9	0.4	23.6	71.2
A.D. 920-1040									
29SJ 629	1,008	18.6	78.8	45.5	13.5	1.9	0.8	19.6	41.0
29SJ 1360	1,153	20.3	77.6	39.7	32.0	1.0	1.1	33.6	49.0
29SJ 627	4,832	17.6	80.1	36.7	17.9	1.5	0.6	21.2	44.7
Pueblo Alto	636	29.1	67.8	49.7	19.0	1.1	2.0	28.2	47.5
Small sites	7,012	18.3	79.5	38.5	19.1	1.5	0.7	22.7	59.8
A.D. 1040-1100									
29SJ 627	787	40.2	59.8	38.0	21.9	-	-	29.6	61.6
Pueblo Alto	2,239	38.1	58.1	62.9	26.8	1.4	2.4	41.1	62.7
29SJ 633[a]	48	22.9	72.9	81.8	31.4	4.2	-	43.5	47.8
Small sites	883	38.3	61.5	43.5	23.0	0.2	-	30.9	61.5
A.D. 1100-1200									
29SJ 627	286	50.0	50.0	39.9	58.7	-	-	49.3	77.6
Pueblo Alto	820	27.4	62.0	60.4	40.6	6.7	3.9	46.2	61.9
29SJ 633[a,b]	49	12.2	87.8	(50.0)	41.9	-	-	42.9	69.4
Small sites	424	40.1	59.0	42.9	50.8	0.9	-	47.6	71.9
A.D. 1200+									
29SJ 633	151	24.1	68.5	46.2	51.4	70.4	-	50.0	60.0

"Early sites" is a combination of sites 29SJ 299, 29SJ 423, 29SJ 721, 29SJ 724, 29SJ 628, and 29SJ 1659.

"Small sites" is a combination of sites 29SJ 627, 29SJ 629, 29SJ 633 and 29SJ 1360; all tabulations include added 29SJ 627 culinary sherds.

[a] Note small n.

[b] Indicates groups that are placed strictly on typological basis, thereby excluding most redwares and polished smudged and having sample size problems.

of sources represented is somewhat unclear because of the ill definition of two of the largest temper groups. Coarse sandstone-tempered whiteware, abundant trace trachyte-tempered whiteware, and abundant trachyte-tempered whiteware suggest greater diversity than is evident in the import percentages. The final period at Pueblo Alto shows a remarkable contrast in diversity to the A.D. 1040 to 1100 segment. This is especially so because both coarse sandstone and more-sandstone-than-trachyte remain high-frequency tempers in the last period. As echoed in the trash mound lithics (Cameron 1987), the link to the Chuska area is very strong and is critical to really understanding Pueblo Alto. At the same time, it should be kept very much in mind that around half the ceramics are probably not from the Chuskas, but from a diversity of sandstone-using sources, many of which were outside of Chaco Canyon.

The percentages of imported vessels repeat consistently enough to seem to be reasonable estimates of the prehistoric fact. Of equal interest, but more elusive, are estimates of the actual quantities involved. Such estimates have been attempted in several places (Toll 1984, 1985; Toll and McKenna 1987, 1992, 1993), and they indicate that ceramic consumption at all of the sites excavated was considerable. The estimates for total numbers of vessels at the sites range from 1,700 vessels at 29SJ 629 to 150,000 at Pueblo Alto (Toll and McKenna 1987: 208). Indeed, the volume rather than the kind of pottery best distinguishes Pueblo Alto from the other sites ceramically. The volume estimates rely on estimated unknown volumes of unexcavated deposits and are clearly crude approximations. Granting that the vessel control for the analysis samples is less crude, even the excavated material in the analyses indicate over 20,000 vessels, and the excavated materials cannot possibly represent even one percent of the total deposits in central Chaco Canyon (back to estimating the unknown). We will never know exactly how many vessels were imported to Chaco Canyon, but we can be quite sure it was a very large number.

While it can be established that a huge quantity of the pottery found in Chaco Canyon was not made there, explaining that fact is considerably more difficult. Because the increase in ceramic import is evident at small and large sites, and because it continues late, at least part of the import to the canyon seems readily attributable to need. Fuel shortage was almost surely a factor. At more abstract levels, the interchange of material goods, especially message-laden ones such as ceramics, is likely to fulfill social functions as well. Means of production and possible meanings of vessels are discussed in the next section.

The Distribution of Trachyte Temper in the San Juan Basin

Skunk Springs is a greathouse community in the Chuska Valley near the probable geological source of trachyte (Mills et al. 1997; Stoltman 1996). Figure 2.15 plots distance from Skunk Springs against percentages of trachyte temper in gray- and whitewares at eleventh and early twelfth century greathouses for which ceramic data are available. The data range from extensive excavation analysis at Salmon and Pueblo Alto to surface sherd analyses (primarily from Marshall et al. 1979, Powers et al. 1983). Except for updated figures for Casamero and Pierre's Site (from Mills 1988), the data are presented in Toll (1985:443-444). The overall distributions show fall-off of trachyte occurrence with distance; various sites' relationship to the regression lines for each sample are instructive. Whiteware vessels break into fewer sherds than do graywares, but even accounting for that difference, it is likely that more graywares were being moved. The correlation between distance from Skunk Springs and trachyte-tempered grayware ($r=-.764$ for 33 cases, Figure 2.15A) is higher than that for whiteware ($r=-.650$, Figure 2.15B), although both correlations are significant ($p<.001$). Contributing to a less steep fall-off line for the whiteware is the presence of one or two sherds at a great distance. Even with the smaller amounts of whiteware, percentages of white and gray Chuskan wares are correlated ($r=.81$)—that is, where larger quantities of Chuskan grayware are found, Chuskan whiteware is also likely to be relatively abundant.

The distribution does show a corridor effect pointed out by M. P. Marshall (personal communication 1985), with higher trachyte occurrence in the west and northwest from greathouses to the west (Newcomb, Great Bend, and Lake Valley), all of which fall above the confidence bands, along with

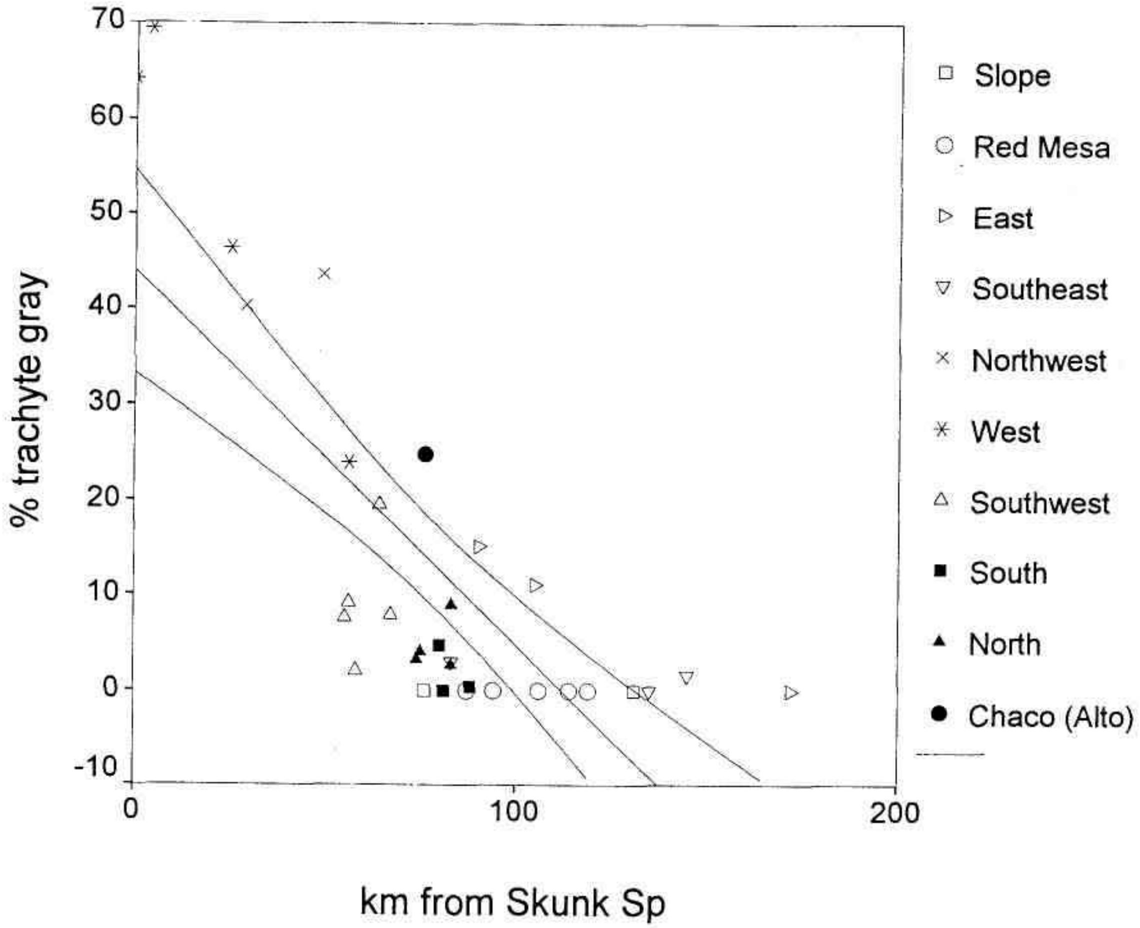


Figure 2.15A. *Scatterplot showing the fall-off of trachyte temper in grayware with increased distance from the Chuska Valley. The sites shown are greathouses dating to the early A.D. 1000s and early A.D. 1100s. Sites are keyed by sectors of the San Juan Basin (see Marshall et al. 1979). The y-axis shows trachyte-tempered grayware as a percent of the total ceramics in a collection. The one site in Chaco Canyon is Pueblo Alto; the high grayware percentages are the Skunks Springs and Newcomb greathouses. The Pearson's r for the regression line shown is -.76 (n=34, p=.000), with 95 percent confidence bands shown.*

Pueblo Alto. The lower trachyte occurrences in sites to the southwest, which are off the corridor (Kin Klizhin, Kin Bineola, Indian Creek, Standing Rock, and Peach Springs), but still closer to the Chuska source, placing these sites outside the confidence bands, reinforce the impression of the corridor. Roney's (1992) reevaluation of roads suggests that the once-postulated west road is more likely to have been greathouse-centered segments than a fully constructed road from Chaco Canyon to Skunk Springs, but, formal road or not, these plots serve to emphasize the special relationship between Chaco Canyon and the Chuska Valley and show a likely route of import.

There are numerous cases to the east and south of Chaco Canyon, including the verified South Road, the Red Mesa Valley, and the Chaco Slope, for which little and often no trachyte temper is reported in either ware. These cases are clearly below the

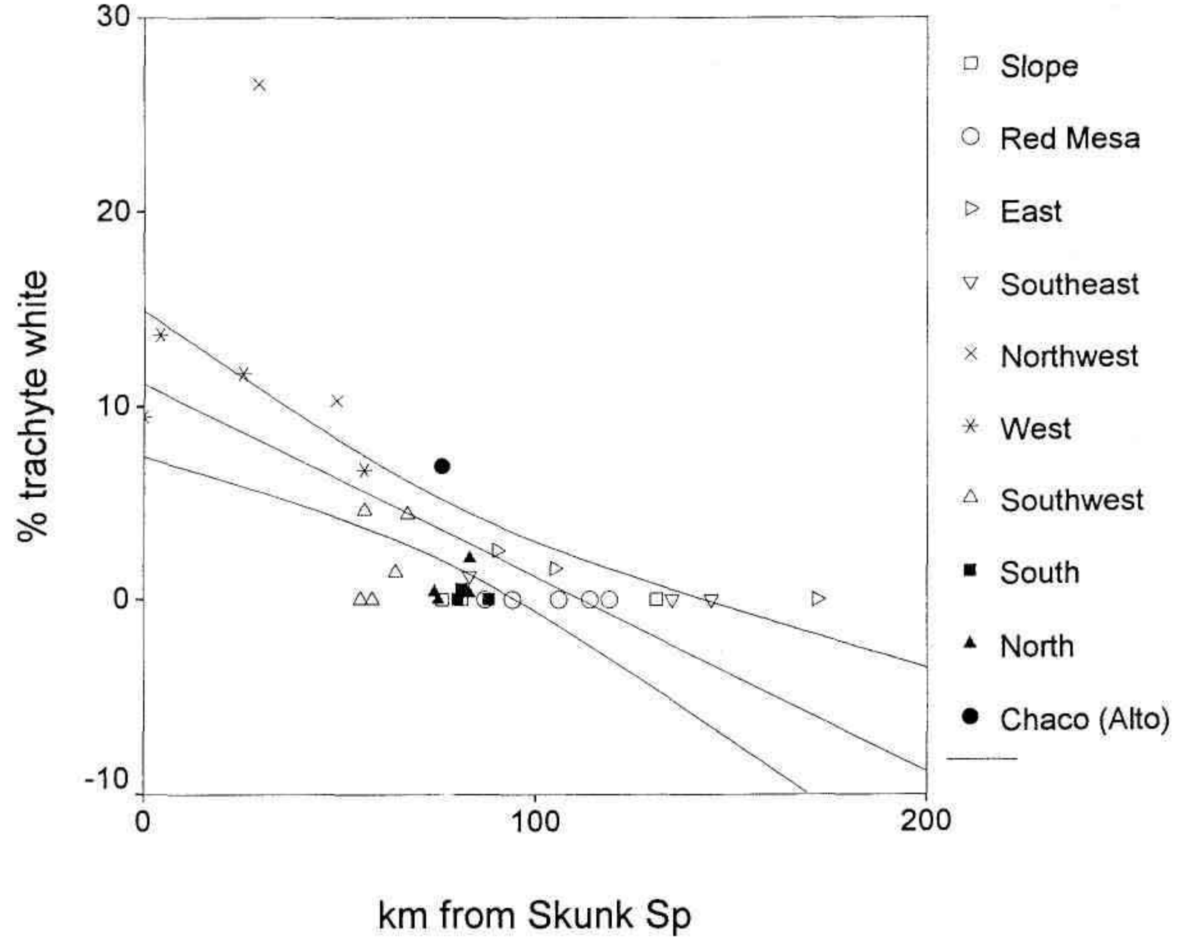


Figure 2.15B. *Scatterplot showing the fall-off of trachyte temper in whiteware with increased distance from the Chuska Valley. The sites shown are greathouses dating to the early A.D. 1000s and early A.D. 1100s. Sites are keyed by sectors of the San Juan Basin (see Marshall et al. 1979). The one site in Chaco Canyon is Pueblo Alto; the high whiteware percentage is the Sanostee greathouse. The Pearson's r for the regression line shown is -.65 (n=33, p=.000), with 95 percent confidence bands shown. Note the difference in y-axis scales between whitewares and graywares. Updated from Toll (1985:443-444).*

regression line and outside the confidence bands. While sites such as Guadalupe Pueblo, Kin Nizhoni, or El Rito, at distances of 135 km or more from Skunk Springs, would be expected to have no trachyte according to the regression and confidence limits, sites to the southwest, south, and southeast are predicted to have more than they do. The low frequency of trachyte even at Upper Kin Klizhin, Bee Burrow, and Kin Ya'a, sites on the confirmed South Road (Roney 1992), and the near absence of trachyte to the southeast, is a strong indication that volume movement of Chuskan pottery stopped at Chaco Canyon. Sites on the North Road fall below (Pierre's Site, Halfway House, and Twin Angels Pueblo) or within (Salmon Ruin) the confidence bands for the fall-off line. These occurrences indicate that trachyte-tempered vessels were not concentrated in Chaco Canyon for distribution (Renfrew 1975, 1977) and that formal roads did not have a direct impact on the distribution of pottery. Experiments with removing different sets of sites from the correlation show that there is still a significant negative correlation (-.61) between distance from Chaco and trachyte-tempered grayware when the Chuska Valley sites are excluded, but this is because of the high relative frequency of trachyte in Chaco. Including all sites, or adding the distance between Skunk Springs (the source) and Pueblo Bonito (a possible distribution point) and the distance to a given site to give the distance routed through Chaco, gives no correlation between distance and Chuskan pottery percentage (grayware r=.08, whiteware r=.10). There is much left to learn about these complex relationships, and more data will greatly improve the foundation for further deciphering them.

Ceramic Production in the Chaco System

The sample reported here is a tiny fraction of the ceramic universe: clearly a great abundance and variety of pottery were produced during the entire Anasazi occupation of Chaco. Thus far, we have described the variability and our recording of it, and what we were able to surmise as to the changing sources of Chaco Canyon ceramics. Specialization—whether administrative, agricultural, or in production of elite or mundane goods such as ceramics—has direct bearing on deciphering social organization in the Chaco system (see Rice 1987:188-191). Ceramic production in the Chaco system may be studied from several perspectives: ceramic production in Chaco Canyon; consideration of variability and consistency in graywares; sources and transport of pottery; and discussion of the possibilities for specialization in ceramic production (see Mills and Crown 1995). This section is a condensation of a more detailed treatment in Toll (1985:224-368).

Methods of Manufacture

There is a standard formula for Anasazi methods of making ceramics which includes building by coiling, scraping, polishing, slipping, painting and firing in a "reducing" atmosphere, with variations depending upon the ware. We cannot greatly refine that formula, but several aspects of what we do know about ceramic methods bear upon organization of production, especially in later types.

Material Acquisition

Clay is one of the most abundant materials in the San Juan Basin. Too little is known about ceramic composition to determine the degree to which prehistoric potters acquired clay from very particular locations (as among traditional Acoma potters today), or more generally, from the many locations where clay could be obtained. Intra-regional variation certainly exists, but we are far from fully comprehending it. At present, we must assume that no special skill or effort went into obtaining body clay.. Judging from its sparing use, slipping clay seems to have been scarcer than body clay. Arnold (1980:149; 1985) has found that slipping and painting materials are far more likely to be transported long distances than tempers and clays. Knowing from whom or where to get such materials would have required special, although not esoteric knowledge. Tempers were certainly carefully selected. Chuskan potters used only trachyte, and archeologists spent years looking for its exact source (see Temper and Paste section). Coarser quartz sand (either in sandstone matrix or free) would also have required some special knowledge to acquire and process, as would the proper sherds for use as temper. Still, there is nothing in this phase of manufacture that implies either the skill, knowledge, or time investment of a specialist.

Molding

There is no reason to suspect anything other than coil construction with surface modification: some combination of scraping, corrugation, and polishing. The skill levels here were considerable in some cases. The ability to produce large, complicated forms that are symmetrical, thin-walled, and strong, implies that the time devoted to potting was sufficient to qualify as a specialization (see also Shepard 1956, 1963). Still, both ancient and modern Pueblo pottery conform to Balfet's observation that,

> "These seasonal operations [by elementary specialists], sometimes recurring at closer intervals, are repeated often enough to ensure a certain skill and even a certain

routine, which leads to a work rhythm and often to a quality apparently at variance with the crudeness of the means employed" (Balfet 1965:170).

Decoration

The same may be said for some of the designs seen on whitewares and redwares. Some of these show great complexity of design (try copying some of them) and superb brush control; others show neither. McKenna has suggested that hachure was a means of filling design elements quickly as a time economy in the production of pots by specialists. The opposite may be argued; careful hatching could easily take more time than solid elements. Acoma potter Mary Lewis Garcia, who uses both filling techniques, finds hatching to be slower (personal communication 1981). Whether faster or slower, numerous Anasazi designs also form circumstantial evidence for skills unlikely to be universal. Balfet (1965:168-169, 1981:263-264) notes that North African items produced in bulk for sale exhibit less care both in finish and construction than do some items produced for the potter's own use. High quality does not, then, necessarily indicate specialized mass production, though standardization may.

Facilities

Among excavated sites in Chaco Canyon, there do not seem to be facilities for large scale material preparation, although there is scattered evidence for clay processing (Table 2.67). McKenna and Windes (1995) suggest that round surface rooms at sites 29SJ 626 and 29SJ 627 could have served for drying vessels. The room at 29SJ 626 has a flagstone floor and no features; the room at 29SJ 627 has grinding features on its latest floor (Truell 1992:184-188). Until recently, few pottery firing features had been identified in the Southwest; on the whole, it seems likely that the open-ground firing now in use among Pueblos was the most common prehistoric method as well, although some means of producing a reducing atmosphere would have been necessary to optimize vessel strength with the available clays and to minimize fuel use (Blinman and Swink 1996). Extramural burned areas of varying size may have been for firing pottery, but they may have been for many other things as well (Stark 1984). Morris (1939:111-112) and Shepard (1939:261-267) tentatively identified a pit found at Morris' Site 41 (a large community with greathouses in the La Plata Valley) as a kiln with a flue; it may be similar to a feature in Chaco Canyon at Bc 236 (Bradley 1971; see Table 2.67). If these are closed kilns rather than roasting features or fired storage features, they seem to be isolated occurrences. A second feature at Bc 236 has layers of charcoal overlain by rock and then a possible quenching layer similar to the Anasazi kilns north of the San Juan River, but is again an isolated instance in recorded features.

A number of features identified as trench kilns have recently been found in the Mesa Verde area and as far south as the La Plata Valley (Purcell 1993). These tend to have post-A.D. 1100, carbon-painted ceramics associated with them (Fuller 1984; Purcell 1993:144; Wilson and Blinman 1995:76), although Brisbin has excavated similar features which contain Pueblo II and Basketmaker ceramics in Mesa Verde National Park (see Purcell 1993:144). Additionally, a Pueblo I kiln has been reported (Heacock 1995: 406), indicating that the pit kiln technology may long antedate the carbon shift. Generally, trench kilns are located away from habitations, often on wooded slopes where fuel would be available and draft conditions good. Such features have not been found in the San Juan Basin, though Fuller (1984:54-55) notes that their recognition depends on an awareness of these features that has only recently developed (see also Blinman 1992; Blinman and Swink 1996; Post and Lakatos 1995). McKenna and Windes (1995) speculate that the plentiful isolated firepits on the slopes of Chacra Mesa could have been Basketmaker and Navajo firing locations.

The large number of presumed kilns in a fairly small area reported by Fuller raises two possibilities. There may be many more Anasazi firing loci than has been appreciated, as suggested by the continued discovery of multiple examples. At the same time, this particular area may represent the production of large quantities of pottery by a specialized community. The large size of many of these late trench kilns (up to 8.6 m long; see Heacock 1995; Purcell 1993:128, 143-145) does suggest that specialized potting communities were an Anasazi development, at least by late in the Chaco sequence (see also Heacock 1995: 406-408).

Table 2.67. All known suggestions of evidence for ceramic production at sites in Chaco Canyon.

Site	Period	Evidence Cited	Reference
29SJ 299	BMIII	Polishing stones and sherd scrapers in association with unfired sherds, stylistic uniformity.	Loose n.d.
29MC 448	BMIII	Hemispherical ground sandstone molds, burned pinched clay, grinding tools, open hearths (possible kilns).	Powers and McKenna 1984 field notes
Shabik'eschee	BMIII	Unfired sherds, uniformity of ceramics.	Roberts 1929
Half House	PI	"Two rolls of slightly fired clay" apparently intended for vessel construction.	R.N. Adams 1951
Judd's pithouses	PI	Small mass of kaolin.	Judd 1924
Pueblo Bonito	PI-PIII	Kaolin cakes, paint, prepared raw clay, no kilns, but large ovens.	Judd 1954; Roberts 1927
29SJ 1360	PII	Polishers, scrapers, raw clay, miscellaneous circumstantial evidence (design, etc.)	McKenna and Toll 1984
29SJ 629	PII	Paint materials, polishers and scrapers.	Windes 1993:211, 227
29SJ 626	PII	Ball of coarse-tempered clay with polishing stones embedded; many possible scrapers; drying room.	McKenna and Toll 1984:386 McKenna and Windes 1995
Bc 50	PII-PIII	Paint materials, polishers, abrader, mortar.	Brand et al. 1937
Pueblo del Arroyo	PII-PIII	Uniformity of decoration, abundance of carbon paint. Four kaolin cakes; scrapers; possible paint pallet stone.	Roberts 1927 Judd 1959:140
Bc 362	PII-PIII	"Clay mine" pit beneath rooms; presence of metate bins in the pit may indicate pottery clay mixing. Polishing stone; no unfired clay recovered.	Voll 1964
Łeyit Kin	PIII	Unfired clay sherds and coil; associated with early PIII carbon-on-white pottery.	Dutton 1938
Bc 236	PIII	Masonry-lined hearth with vents, located on the bank of the Chaco Wash; possible kiln with layered charcoal, rock, and soil; polishers.	Bradley 1971
29SJ 299	PIII	Burned 1.5 x 0.7 x 0.1 m pit containing ash, some sherds.	Loose n.d.; McKenna and Windes 1995

These kilns raise several questions as well. Why are most of the identified kilns late? Does this mean that there was a change in firing technology or one in the organization of production? Does their appearance somehow relate to the approximately contemporaneous widespread shift to carbon paint? If there was a change in technology, will earlier production sites be recognizable? The kilns seem to have been mainly for firing whitewares; what do grayware firing facilities look like, and how were graywares successfully reduced? Now that patterns, stratigraphy, location, and contents of more formal pottery firing features have been identified, more and more firing features will be found (Post and Lakatos 1995).

Given current evidence, however, we must continue to assume that what pottery was produced in the Chaco region south of the San Juan was fired in the open. Open firing is used by specialists, e.g., in Guatemala (Reina and Hill 1978; Rice 1987:153-158). Ironically, modern Pueblo potters who are considered by both the market and other potters to be the true experts and who are most clearly today's specialists are those who eschew modern technology and fire in the open. Thus, the potter who "produces" mold-made pottery, who buys commercial materials, who fires in an elaborate electric kiln is regarded as making a much less desirable and less valuable pot than the potter who digs her own clay, hand molds and finishes her pots, and fires them in an open fire. The lesson here is that "correctly" made pots (by whatever definition) are likely to have greater value than otherwise similar vessels.

Personnel

Pottery-making was probably not something that everyone of the appropriate age and sex did. Further, especially in Chaco Canyon, it probably did not occur at every village and, through time, the number of individuals making pottery relative to the population probably decreased; perhaps the relative number of pottery producing villages decreased as well. Nonetheless, pottery was made in a large number of areas. Some areas or villages probably made substantially more than was used at the site of production. The most notable and discernible of these was the Chuska Valley, where there were probably numerous producers.

This scenario does contain specialized potters, but what was their nature? Based on ethnographic situations, it seems likely that potters in the system worked on an individual family basis and that the facilities involved were fairly minimal. Admirable skill levels were clearly present, but mass production in the sense of assembly lines with segregated tasks and vast volume was not likely. Speculatively, sole reliance on the production of pottery as a means of livelihood was probably a result of unusual circumstances and necessity, such as when an individual had no appropriate kin for other subsistence pursuits, rather than an actively sought, or dictated, way of life.

Evidence for Ceramic Production in Chaco Canyon

There are multiple ways of studying ceramic production and specialization (e.g., Rice 1981, 1987; Toll 1985; Wilson and Blinman 1995:64-70). At the finest level, it may be possible to identify individual potters, possibly through burials (e.g., Crotty 1983) or through attributes of the artifact (e.g., Hill and Evans 1977; Huse 1976; Redman 1977). A second important avenue is through the analysis of production sites (Kramer 1985; Peacock 1982; Stark 1984), although caution must be taken to ascertain whether a specialized production site means specialized producers (Muller 1984; Rice 1987:189). Finally, the ceramic assemblage itself may be examined for evidence of standardized production (Hagstrum 1985; London 1991; Longacre et al. 1988; Muller 1984; Rice 1981; Trinkaus 1983), or especially expert craftsmanship (Brody 1977; Fry 1979, 1980).

Identification of Individual Potters

On the whole, burial assemblages from Chaco Canyon are poorly known, but potter's tool kits assemblages similar to those reported by Crotty (1983) from the Kayenta area are not among known Chaco burials. While some burials include tools such as awls and fleshers, none appears to contain pottery scrapers or polishers (Akins 1986). Probably the most common Anasazi grave good (with man, woman or child) is some form of ceramic vessel, and the determination of the production significance of ceramic grave goods relies heavily on context and inference. At the least, burial goods constituted a substantial consumption of vessels over and above the needs of the living.

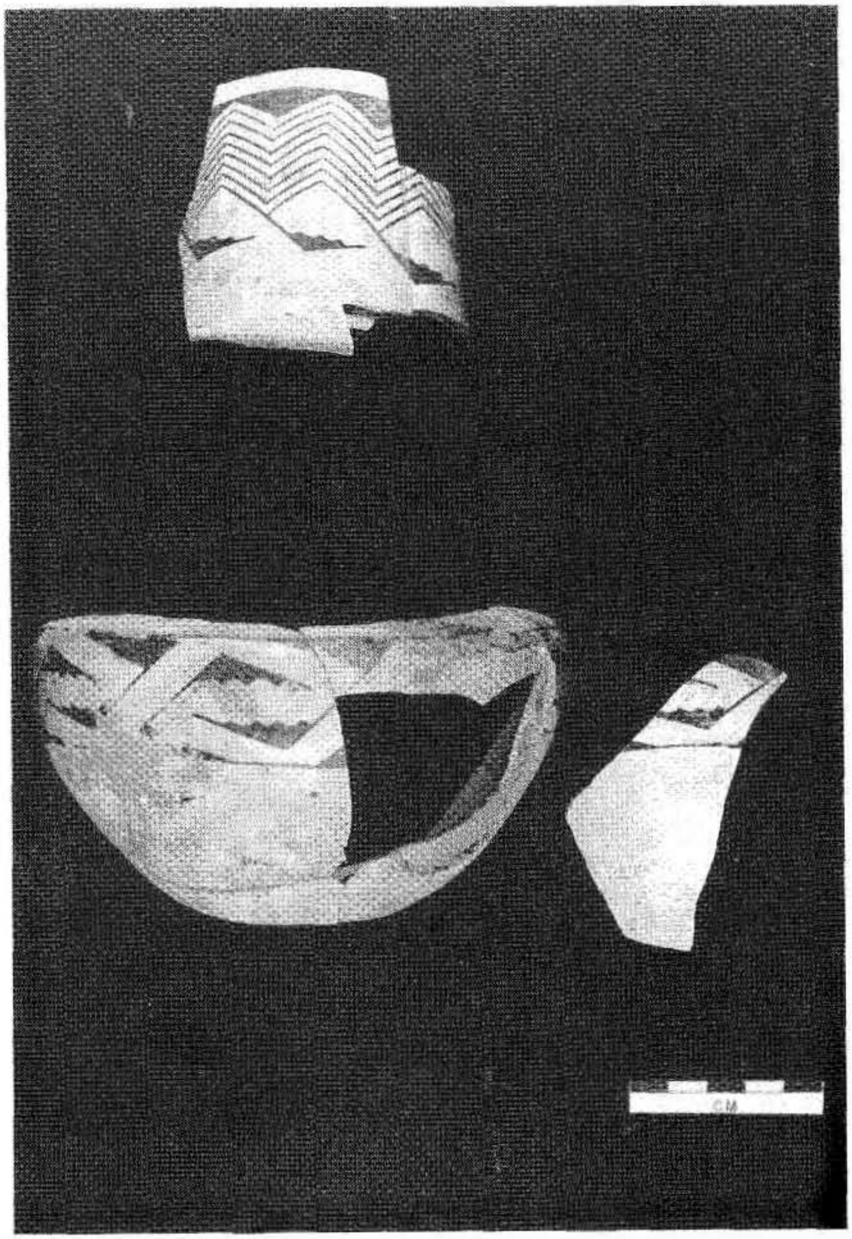
The Chuska Valley is a prime source for some classes of pottery found in Chaco Canyon, so that searches for evidence of specialization in ceramic production make at least as much sense there as in Chaco Canyon. There were apparently large burial populations with abundant ceramics in the Newcomb vicinity; these are unreported and now probably lost (Lister and Lister 1968:70-74). In this same area, there are at least two outlier communities—Skunk Springs and Newcomb (Marshall et al. 1979). As first suggested by Shepard (1956, 1963) and corroborated by Chaco Project findings (e.g., Toll 1981, 1984), the volume of Chuska ceramics in Chaco Canyon is evidence that a production-consumption relationship existed between Chaco Canyon and the Chuska Valley that is very different from local supply. Future researchers in the Chuska Valley should be alert in order to identify potter's tool kits and pottery production sites. Pottery manufacture has, in fact, been suggested for Little Water, a Basketmaker III site on the Sanostee Wash in the northern Chuska Valley (Condon 1982:43-45, 204-207). Although fuel wood sources are not adjacent to the Little Water site, other pottery materials are. The primary evidence cited by Condon are complex hearths with substantial fuel waste build up (primarily corn stalks) and abundant burned sandstone which could have been used to separate vessels from fuel during firing. The hearths are much less formal than the later pit kilns in the Mesa Verde region and are not slab-lined. All have some depth; several in the 40 to 60 cm range were reported for later kilns (Purcell 1993:128). Failed vessels and large cover sherds are apparently absent.

Huse (1976) found that exterior markings on bowls from the precontact Hopi site, Kawaika-a, were the most consistent means of grouping vessels in potter groups. While such markings are much more common on pueblo pottery that is later than most Chaco pottery, there are examples of markings referred to as "ownership marks" that could as easily be potter's marks (Table 2.16C; Windes 1984b:101-102). These marks can either be simple painted lines or figures in slip clay on an unslipped bowl exterior. In later types (Mesa Verde Black-on-white or St. Johns Polychrome) the exterior markings become much more elaborate designs which are more likely to be decorative or symbolic rather than ownership markings. There are also some pieces among the Chaco Project ceramics that stand out for their exceptional decoration and manufacture. We think we can identify as the products of "our lady" (Figure 2.16), but other than noting them, no systematic program of further testing whether they came from a single source and maker has been attempted.

Using surface sherds from a number of the greathouses in Chaco Canyon, Weigand (1977) attempted to identify potters by means of fingerprints on corrugated vessels. This pilot study was able to place only about 4 percent of over 430 sherds into two tentative groups, and planned complementary neutron activation studies were not completed (P. Weigand, personal communication 1986). One of the two groups of sherds that could be attributed to individual potters contained 16 sherds, 14 from Pueblo Bonito and two from Pueblo Alto. Two other sherds showing an identifiable fingerprint came from Pueblo Alto and Pueblo del Arroyo. Temper information is not provided, but there is some suggestion that single individuals were providing vessels used at multiple greathouses.

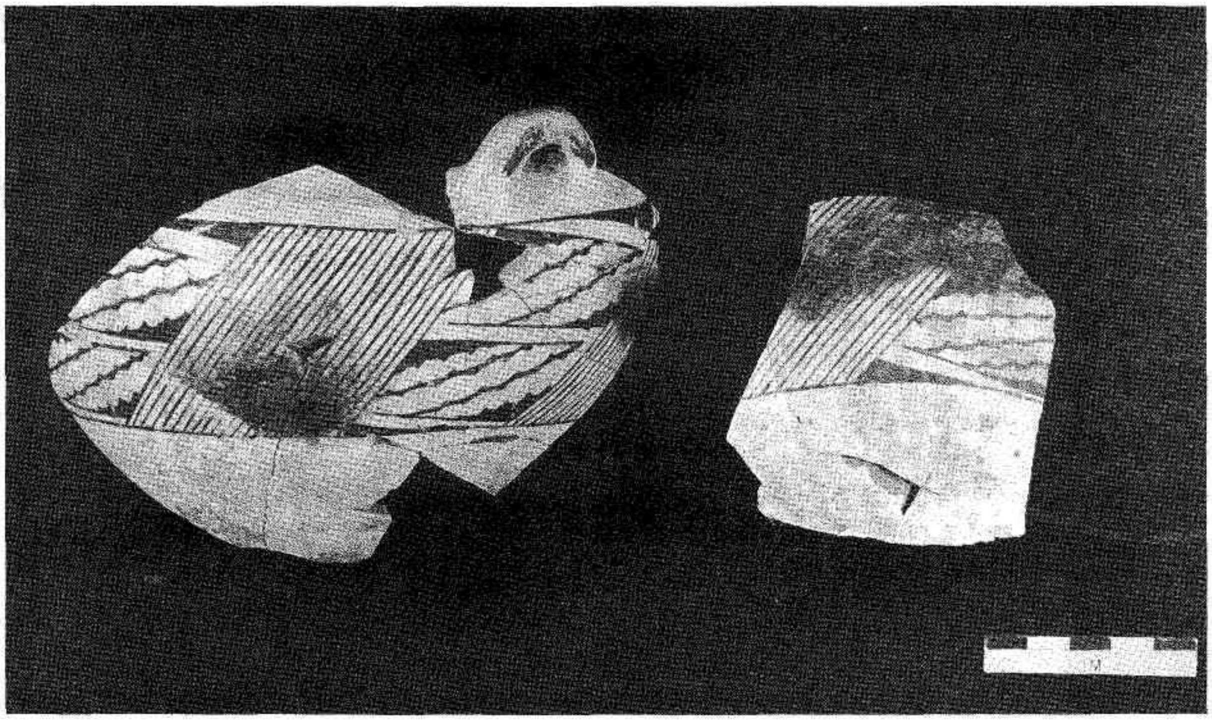
Evidence for Manufacture

Chaco Canyon sites seem to contain smaller numbers of pottery-making tools, scrapers, polishing stones and perhaps pukis—usually pot bottoms used to support and turn a piece as it is formed (see Christenson 1991; Sullivan 1988)—than would be expected from the quantities of pottery present in the Canyon. Table 2.67 presents all the instances we know of in the literature claiming evidence for pottery production in Chaco Canyon. Earlier Chaco Canyon sites (Basketmaker III-Pueblo I, ca. A.D. 700 to 900) provide more convincing evidence for ceramic manufacture than do sites dated to Pueblo II or later, in spite of the lower excavation volumes from earlier time periods. In Chaco Project sites, there are large sherd scrapers of the sort usually interpreted as ceramic tools at 29SJ 299 in the Basketmaker component (Figure 2.17), but such scrapers are rare or absent later. Akins (personal communication 1980, this volume) notes that polishing stones are also very low in frequency later. Identified examples of potting clay in any state of



A

Figure 2.16. *Examples of extremely fine workmanship, possibly the work of a single potter ("our lady"). All are Red Mesa Black-on-white with fine line control, similar scalloped triangles in dense black mineral paint and hard, thin, well-polished, sand and sherd tempered walls. These items come from various sites: A) 29SJ 1360; B) 29SJ 629; C) 29SJ 627; and D) Bc 236, Una Vida, Una Vida/29SJ 627/29SJ 628, 29SJ 1297, 29SJ 629. Other possible examples are known from the sites shown and Łeyit Kin and the San Diego Museum of Man collection (one from "Fajada Butte"). (NPS Chaco Archive Negative Nos. 59395, 59403, 59407, and 59419).*



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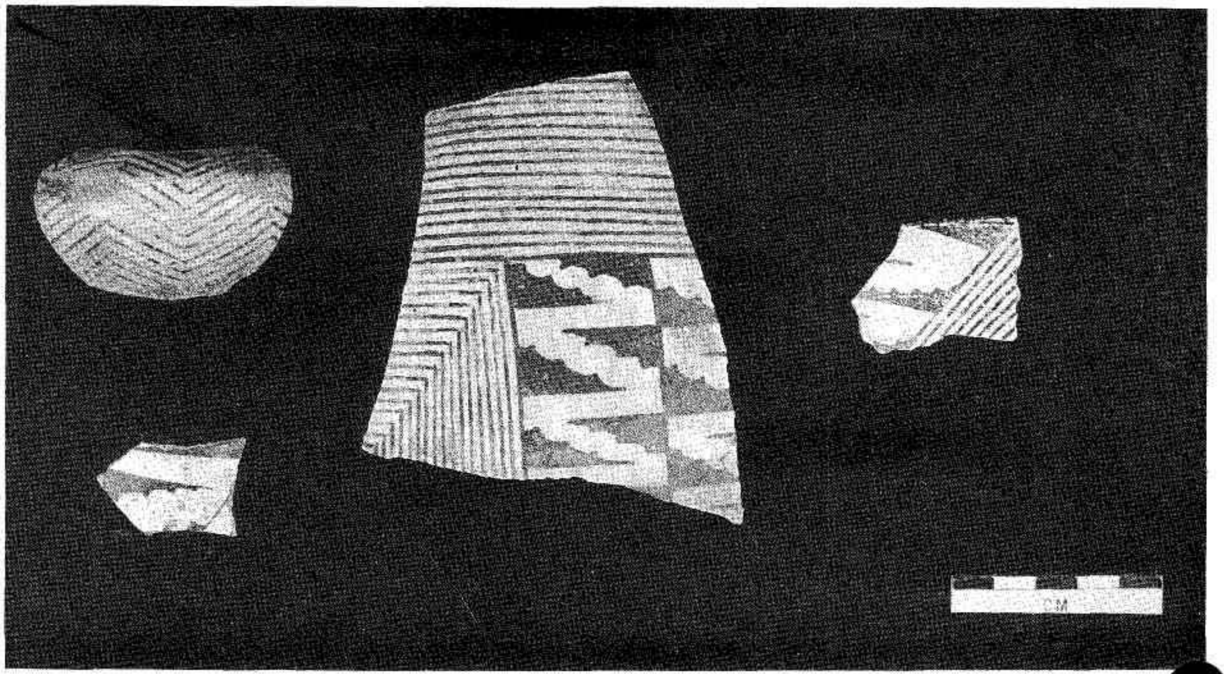

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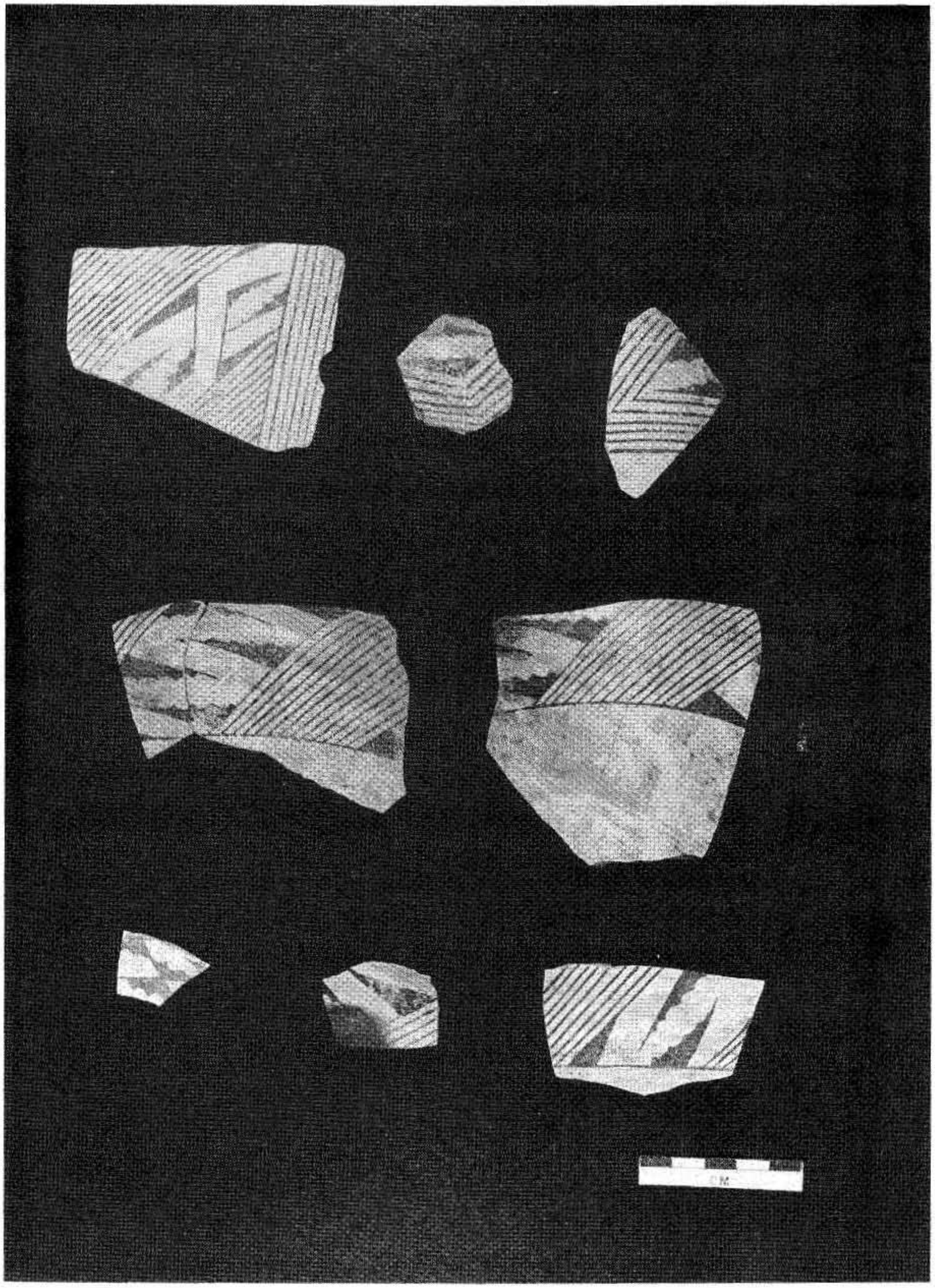
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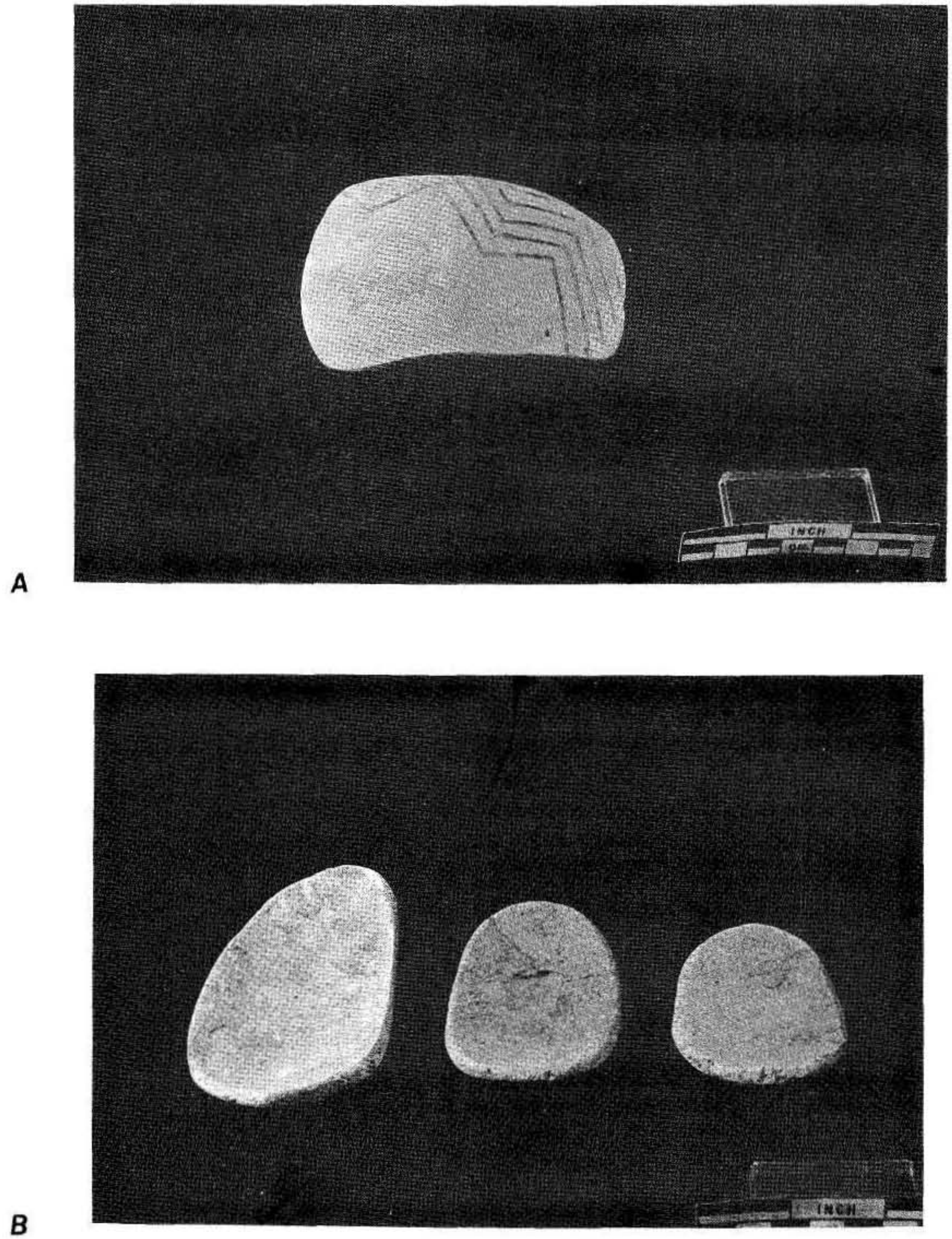

Figure 2.17. Pottery scrapers from 29SJ 299, Pithouse A. Except in early contexts such as this one, pottery making tools are uncommon in the Chaco Project ceramic assemblage. A) from 29SJ 299; B) from 29SJ 362 (NPS Chaco Archive Negative Nos. 13998 and 14003).

preparation are also rare (Table 2.67). While Judd found some such evidence for pottery-making, he remarks on its small amount at Pueblo Bonito (1954:184-185). Somewhat at odds with this statement, Judd (1954:137n) reinterprets rooms that divide the plaza at Pueblo Bonito as a location where potting clay was ground. Pepper (1920:84-86, 112), who excavated the rooms, considered the grinding here to be ceremonial. Pepper knew about the white sandstone Judd suggests was being ground instead of corn, so the likelihood that Pepper misidentified the substance being ground may be less than Judd suggests. No pottery manufacturing materials have been identified from Pueblo Alto. This paucity of ceramic production tools and facilities contrasts with the northern San Juan area, where most sites contain pottery production evidence (Wilson and Blinman 1995:74).

At 29SJ 1360, a Pueblo II site, there is some evidence for on-site pottery-making (McKenna and Toll 1984:203-206). The evidence cited includes polishers, some worked sherds that <u>might</u> have been scrapers (they are not "classic" pottery scrapers, however), some untempered clay and consistency of decoration seen in the assemblage of whole vessels. Of all the sites excavated by the National Park Service in the 1970s and 1980s, the best evidence for production comes from 29SJ 626, an early A.D. 1000s small site, where tempered clay and polishing stones were found together, and scrapers were present on the site. There are many large firepits in Chaco Canyon, but there is no indication that they were used for firing pottery (though, again, the pit kiln pattern had not been established when that work was done). The feature at Bc 236 (Table 2.67) is suggestive, but lacks other corroborative evidence. Some of this lack of evidence for pottery production may come from insufficient excavation of exterior areas (Sullivan 1988), but the scarcity of pottery tools suggests that pottery production in Chaco was in fact uncommon.

Ceramic Ecology and Chaco Pottery

Ceramic ecology is a concept originated by Matson (1965) and developed by Arnold (e.g., 1975, 1976, 1978, 1985). As used by Arnold, ceramic ecology examines the interaction of environmental factors and social strictures as they affect where pottery is made and who makes it. In ethnographic studies in Guatemala and Peru, Arnold has found that specializations in ceramic production have consistently developed in areas with poor agricultural potential. The primary causes for this development seem to be, first, that people confined by land availability or ownership to unproductive locations need to supplement their income above what, if any, crop production they can manage. Second, a frequent concomitant to poor agricultural potential is availability of ceramic raw materials, that is, steep slopes and clay exposures are bad for farming but provide access to an alternative, if less desirable (Diaz 1970), means of subsistence. Especially in the context of a regional system proposed to be a resource equalizer and hedge (as per Judge 1979), these sorts of stimuli to ceramic production have considerable appeal. It is, however, not possible to make an easy fit from Arnold's cases to the Chaco Canyon and Chuska Valley cases.

There is considerable debate about Chaco Canyon as a garden spot. While it has been historically possible to produce crops in Chaco Canyon (Cully et al. 1982; Toll et al. 1985), and while Vivian (1991) and Sebastian (1992) are convinced that a substantial population was supported by farming and surplus production in Chaco, there is little doubt that it was a chancy place for horticulture. In some respects, then, Chaco Canyon might seem a logical place for the development of a specialization hedge. Ceramic evidence suggests, however, that the best place to look for ceramic specialists is in the Chuska Valley, and explaining the long distance transport of volumes of ceramics from the Chuskas to Chaco remains a challenge.

Ceramic production has four basic requirements: clay, temper, water, and fuel. Comparison of the availability of these elements in Chaco Canyon and the Chuska Valley is necessary to discuss the location of production. Arnold has also provided a summary of distances that ceramic materials are transported in a wide-ranking ethnographic survey. Table 2.68 extrapolates from Arnold's (1980:149; Arnold 1985 for greater detail) textual data presentation; some of the percentages are off a point or two from those he presents. These figures provide two things: 1) the most concrete argument for the assumption that pots rather than ceramic materials

Table 2.68. Arnold's (1980:149) ethnographic sample of distances travelled to obtain ceramic materials.

Material	Sample No.	Range km	Preferred		Middle		Maximum		Residual No.
			km	No.	km	No.	km	No.	
Clay	61	1-31	1	22	4	24	7	10	5
Temper	28	1-25	1	16	-	-	5	27	1
Slip and Paint	24	10-880	10	9	40	16	?	?	8

Distances should be read "or less"--the maximum range for acquiring clay is 7 km or less, of which Arnold has 10 examples.
"Maximum" stands for maximum economic range established by empirically based thresholds.
"Residual" cases are those apparently not falling into one of the threshold groups.

were imported to Chaco from the Chuskas, a distance of around 70 km (Toll 1985:III-10); and 2) they are context for the present ecological and raw material considerations. Unfortunately, they do not include figures for fuel transport, but Arnold (1978) does state that the weights of fuel, clay, and temper required for a pot are approximately equal, presumably placing fuel in the same general distance range as clay and temper.

Clay. As has been noted, clay availability seems unlikely to have been a limiting factor to ceramic production in most of the San Juan Basin, though certainly the quality and suitability of clays is variable over this large area. Windes (1977:294-297), for example, suggests that the red-oxidizing clay used in many Chuskan ceramics may have greater strength and porosity and better carbon paint binding qualities than other San Juan Basin clays.

Temper. Nor would tempering material be a limitation; sherd temper gained steadily in popularity as did its availability in Chaco Canyon. Sand and sandstones, while variable, are ubiquitous. Coarser sands such as those used in graywares, are harder to come by in Chaco Canyon (see Temper Section), but they are available within the radii suggested by Arnold's research (Table 2.68). Trachyte makes an angular temper with high feldspar content that probably has favorable thermal shock qualities (Bronitsky and Hamer 1986; Rye 1976), and its abundant use shows that it was a successful material. Other tempers clearly also worked; in fact, sooting (evidence of use over fire) does not show significant association with temper group at most sites (Toll 1984; Toll and McKenna 1987:171-176).

Water. Water was present in Chaco Canyon, although seasonally it was probably in short supply. Annual precipitation is presently low (21.5 cm/8.48 in. per year) and springs are few with low volume (Windes 1987:39-41). No permanent streams are now present, although the washes run irregularly and water storage features have been identified (Lagasse et al. 1984; Vivian 1974). Water could then have been a limiting factor and might help explain why such large numbers of vessels were brought so far (see Vivian 1992).

Fuel. A more likely stimulus to importation of pots, however, is a scarcity of fuel (an argument first applied to Chaco Canyon by Warren [1976:55]). Chaco Canyon and much of the Chaco Basin today are virtually treeless and even brush is not abundant. Chacra Mesa does currently support sparse and stunted pinon-juniper cover and lies within 10 km of a number of sites in Chaco Canyon. Firing ceramics consumes considerable quantities of fuel (Rice 1987:162-163, 174-176). Colton (1951:74) recorded an average of 70 pounds of dung per Hopi firing. When combined with the other fuel needs of a substantial population, the current vegetation would be rapidly depleted by extensive pottery production. The environment was apparently similar to that today, and it has been argued that the Anasazi did deplete fuel wood resources well before the end of their occupation of Chaco Canyon (Betancourt and Van Devender 1981; Hall 1977; Samuels and Betancourt

1982). With fuel abundant only at distances of 50 km or more, its short supply is likely to have limited local production of ceramics and created a need (justifiable in terms of energy expenditure—Arnold 1976) to import ceramics. Reina and Hill (1978) give an example of the role played by fuel in historic Guatemala:

> Production of pottery is threatened in several centers at present simply because the local forests have been exhausted. It is probable that fuel depletion has, in fact, forced individual potters and, in other cases, entire centers out of production in recent years (Reina and Hill 1978:17).

Given the projected population and the minimal vegetation, depletion of fuel for all uses presumably would have been acute in Chaco Canyon by the A.D. 1000s, if not before. Nicklin (1979:446-448), while noting the restrictive effects of fuel shortage, also points out that a great variety of materials have been used to successfully fire ceramics (see also Rice 1987:176). On its own, fuel shortage would probably not have occasioned a complete halt to pottery production but would have been a reason for limiting pottery production, and would have created a need to import vessels.

Portions of the Chuska foothills, such as the Central Area mentioned above, seem to be a much more inviting place to farm and live than does Chaco Canyon (Marshall et al. 1979, especially 100, 113; Wiseman 1982). Taking Arnold's model at face value suggests that the Chuska area should require no subsistence hedge such as ceramic specialization. In addition to the fact that the social complexity and population density were a good deal less in the Chuska and Chaco cases than they are in Arnold's cases, there are several conditions and possible alternatives that may help to account for this apparently non-conforming development:

1) The Chuska Valley and Slope contain considerable topographic and moisture availability variation. While the Chuska foothills do seem to have "everything," the lower parts of the Chuska Valley near the Chaco River are at least as moisture-poor and fuel-scarce as Chaco Canyon (Allan 1977; Hogan 1983; Reher 1977), and parts of the Chuska area were far more intensively used longer than others. The maximum density and extent of population appears to have been in the eleventh century (Wiseman 1982), the time at which the maximum levels of ceramics from the Chuskas were arriving in Chaco Canyon. There was probably a rather complex economy on the Chuska slope itself, including "specialized" villages providing ceramics for both the substantial Chuskan population as well as meeting the large Chaco demand. Although today much of the Chaco region is a major coal source, there is no known evidence from this area for the prehistoric use of coal for ceramic firing such as that found later in the Hopi area (Smith 1971:590). The Chuska area is, however, much closer to the wooded foothills of the Chuskas than is Chaco Canyon; therefore, it may be that the stimulus to produce ceramics as a subsistence hedge was present in the Chuska Valley, especially during the peak population of the area ca. A.D. 1000 to 1125 (Reher 1977:85-90). If firing features are to be found in the Chuska Valley, they could be in the woodlands rather than near the major communities.

2) While the Chuska area has both ceramic and subsistence resources in greater abundance than does Chaco Canyon, some other, less obvious item may have been lacking. Subsistence goods and raw materials including construction timber, lithics, and ceramics could have been their access to that missing item. Judge has proposed two models; the first (1979) holds that the lack was likely to have been in the subsistence realm, while the second (1989) attributes much more importance to control over turquoise. Rather than either only a subsistence hedge or purely symbolic goods, a complex interaction of the two was likely to have been the case. The conditions in parts of the Chuska Valley were probably better than in Chaco, but they were still subject to moisture variability and the likelihood of crop shortfalls (Wiseman 1982). Through participation in the Chaco system, the population of the Chuska foothills stood to gain a hedge against the vagaries of horticultural production under a discontinuous moisture regime. Hard evidence for subsistence hedges remains a chronic problem. Nearly as elusive, especially given the small quantities of controlled excavation in the Chuska area, is the possibility that the "exchange" with the central Chaco area was some form of status good that

perhaps signified participation in the redistributive system.

3) A more direct means of ceramic and other resource acquisition may have been operative. One possible form of such acquisition is direct, perhaps even coercive control over producers in the high diversity areas peripheral to the Chaco Basin. A form of direct acquisition more popular among a number of students of Chaco is the proposition that the large Chaco structures were seasonally used, macro-community efforts, perhaps functioning largely as storage units (Marshall et al 1979; M. Truell and T. Windes personal communication 1980; Toll 1985). Under this explanation, large segments of the Chaco population spent part of each year in more productive locations and brought quantities of what Chaco Canyon lacked when they returned. Vivian (1983) has proposed another variant on this theme. In response to climatic changes, population growth and less favorable farming conditions in the canyon itself, people, rather than goods were redistributed to outlying communities. As Arnold (1985:61-77) discusses, some seasonal conditions are more favorable for pottery manufacture than others. Seasonal occupation of Chaco Canyon, especially in the fall and winter, would have provided an additional reason for ceramics production elsewhere.

Transportation of the quantities of vessels implied by the figures and arguments here is a logistical challenge approaching that of transporting thousands of construction timbers from as far away. Artifacts on roads are mainly ceramics, but Windes found—at least within Chaco Canyon—that exotic sherds do not dominate the pottery on the roads (Windes 1987:128). High local whiteware jar to bowl ratios are a "signature" for road ceramics (Kincaid et al. 1983:9:49, 9:57, 9:62). Pottery vessels do not make especially good sense for long distance transport of grain or other food; given the absence of evidence for import of ceramics on the roads and if ceramics were imported for their own sake (rather than as containers), they may have been brought to Chaco in transport devices such as cacastes or nets (Reina and Hill 1978:208, 222; Thompson 1958), which would have enabled one bearer to carry many pots and would have reduced breakage en route. Rather than a single means of import, circumstances probably meant that vessels arrived in a variety of modes: as containers, acquired by residents, carried in groups by producers. Low frequency of Chuskan utility vessels, however, do suggest that the pottery on roads in Chaco represents local use rather than massive transport.

Standardization and Specialization: Analyses

Specialization in pottery production is widely assumed to result in standardized vessels (Hegmon et al. 1995:33-35; London 1991; Longacre et al. 1988; Rice 1981, 1987:201-204). This assumption is based on the following premises, all revolving around efficiency:

1) Following a set pattern decreases the chances of failure and increases speed of manufacture.

2) Through increased practice, specialists have increased skill levels, resulting in fewer errors and more consistent products.

3) Given that they are producing pots for consumption by others, specialists follow a pattern that is known to be tradeable.

4) In cases where transport of the product is a consideration, standardized vessels are more readily transported in established carrying devices and schemes.

Each of the four main wares found in Chaco (white, gray, red and polished smudged), was subject to different production regimes; questions of social meaning of each ware influence how each is interpreted, and how the production of each is perceived. Redwares and polished smudged wares are found in similar, relatively small quantities throughout the Chaco sequence (Tables 2.1 and 2.6). There is likely to have been greater overlap of production area and technique in the far more abundant graywares and whitewares. After about A.D. 900, a variety of whiteware forms were manufactured, complicating studies of regularity of form and social significance. Whitewares form the most abundant class in terms of numbers of vessels; their production was probably the most widespread and diverse. In terms of numbers of sherds, graywares are the most abundant. Graywares are focal in the following analysis for the following reasons:

1) Metric data are available on four attributes allowing a greater range of analytical techniques.

2) Graywares were produced in great quantity within the core area of the system.

3) Temper distributions suggest that there were areas which produced graywares well beyond local need (Shepard 1963, 1965).

4) There is probably less functional variability within graywares than whitewares. Graywares had numerous functions, but form variety is less than in whitewares.

5) Graywares are an under-exploited source of information about prehistoric lifeways.

Graywares are generally assumed to be utility, non-status vessels, but a case is made here that graywares also had social significance. Specialization in grayware production, especially if graywares were largely utilitarian, has a different significance than specialized production of vessels with more restricted distributions. Such production is more likely a subsistence hedge than a service to an elite. Before turning to the grayware analysis, the other wares will be briefly considered from the production perspective.

Production and supply of redwares fall in a special category in the Chaco system. They are present throughout the sequence (see Import Section), but always in relatively small quantities. Except for a brief period around A.D. 900, when Sanostee Red-on-orange was made in the Chuska Valley (Peckham and Wilson 1964), and not counting vessels with fugitive red washes, redwares do not seem to have been made in the San Juan Basin south of the San Juan River and north of the Red Mesa Valley. Into the A.D. 1000s, redwares found in Chaco Canyon come mostly from north of the San Juan River, probably from southeastern Utah, since they are scarce in Totah assemblages. Toward the end of the A.D. 1000s, redware sources were south of Chaco and in northeastern Arizona. While this steady, long distance import may say something about specialized production in other areas (Ambler 1983), redwares are not part of San Juan Basin ceramic production.

Whether or not redwares were status items is another question. Upham (1982; Upham et al. 1981) argues that the distributions of redwares show that access to them was restricted in northeastern Arizona. In Chaco Canyon, however, redwares are present in all time periods at all sites excavated (e.g., Tables 2.1, 2.2, and 2.6). Polychromes, attributed special significance by Upham, are virtually absent in the Chaco Project collections, but that absence is primarily chronological. Redwares were nonlocal, limited in number and surely had some significance, but their distribution in Chaco Canyon does not suggest they were high status goods. In a large collection of whole vessels from the Rio Puerco of the West, White Mountain Redware bowls (Puerco Black-on-red) were the least metrically variable of several classes of vessels (Toll 1990:284), again hinting at standardized production.

Polished smudged wares have much the same history and kind of distribution in Chaco Canyon as the redwares. It is probable that early in the Chaco sequence, Lino Smudged was made in the Chaco area (though it does have coarse sand temper). Most polished smudged vessels from Chaco Canyon, however, are brownwares likely to have been made in the Mogollon area of southwestern New Mexico and east central Arizona. Again, these distinctive vessels would have been recognized as extra-regional. They probably had some special significance and were produced beyond household need in the outer reaches of the system. They do not, however, have great significance to the production of pottery within the system's core.

Whiteware Production Attribute Combinations. In an endeavor to isolate evidence for production groups, an analytical procedure was devised that examined sherds at the subtype level. Whitewares from four major sites were divided into groups defined by type, temper, and mineral paint color, while graywares were placed by type, temper, and major surface manipulation (e.g., coil width—McKenna and Toll 1984; Toll and McKenna 1987, 1992, 1993). This procedure is similar in concept to the smaller groups sought by Hill and Evans (1977), Plog (1980a), and Redman (1977), but different from each in approach and aim. Redman's and Hill's approaches do not take advantage of technological/source information in forming sherd groups and aspire to isolating smaller production groups. Alternatively, Plog's approach (based on surface treatment, non-geological temper and paint type), is likely to operate at a grosser production level.

Tests of these groups, using other variables that relate to various aspects of production, gave mixed results with both consistencies and inconsistencies among sites. That groups do not fall out neatly makes interpretation more difficult, but it is nonetheless useful background to the examination of the existence of specialization. Because the attributes chosen have a multitude of causes, including time, source area, technological variation, and decorative tradition, it is not expected that the results are subject to multiple interpretations. The results of these analyses may, however, be summarized and an interpretation put forth:

1) Within each whiteware type is a group that is much larger than all the others. The group is that defined by sandstone temper and black mineral paint in all of the mineral paint site-type groups generated. If further subdivided by sand grain size, the fine-medium group is the largest. While the temper category, "sandstone," undoubtedly masks source variability, it is of relevance that a majority of items conform to a fairly specific group of parameters.

2) Among the groups large enough to test, there is usually substantial overlap in all well-represented test attributes. With a large group such as that described above (1), overlap is expected, but even with smaller groups, forms, designs, diameters, and sherd temper content are often statistically similar. When differences are found, the differences frequently do not repeat at other sites.

3) Backdrop of similarity notwithstanding, there are some trends that do apparently identify production preferences. Perhaps the best example of this process is the association of "squiggle hachure" of two sorts, with trachyte temper found at both Pueblo Alto and 29SJ 627. This development is one of the clearest associations and probably occurs well into the production span of Gallup Black-on-white. This association and its timing support the suggestion that there seems to be some increase in areal definition through time. It should be remembered that this decorative technique does occur in other groups, showing that, while some elements may have been used more commonly by some producers, there does not seem to have been exclusive use by any one area. Exclusive use of specific combinations of elements may have existed, but using sherds rather than whole vessels; in the absence of hierarchical and deeper design recording we are unable to assess whether or not specific design and production group combinations exist.

<u>Grayware Attributes.</u> Several approaches are taken here to assess the variability in graywares. To assess degrees of standardization, which are possible indicators of specialized production, these analyses examine metric and decorative consistency within groups. Each of the following analyses controls for type (allowing some time sequencing) and major temper group (allowing for some areal placement by source): 1) standard deviation and coefficient of variation; 2) frequency plots for identification of multimodality; and 3) discriminant analysis and multivariate analysis of variance, testing for classification by both site and temper.

The attributes measured are listed below (Figure 2.18):

1) Estimated orifice diameter. When sherds are sufficiently large, the curvature of the sherd can be used to obtain an estimate of the whole vessel's orifice diameter. This measurement is some index of the size of the vessel, although the correlation between diameter and volume is not perfect and varies with vessel form (r=.89 for grayware jars; Table 2.69; McKenna and Toll 1984:196; Rohn 1971:144).

2) Rim fillet width. A measurement of the last fillet of a vessel which was left visible on all neckbanded and indented corrugated vessels and formed into a rim. This fillet is not visible in plain gray vessels such as Lino Gray.

3) Rim flare. The eversion of Anasazi corrugated jar rims has temporal significance (see below; also Toll and McKenna 1987) and is a prime typological criterion for differentiating Pueblo II,

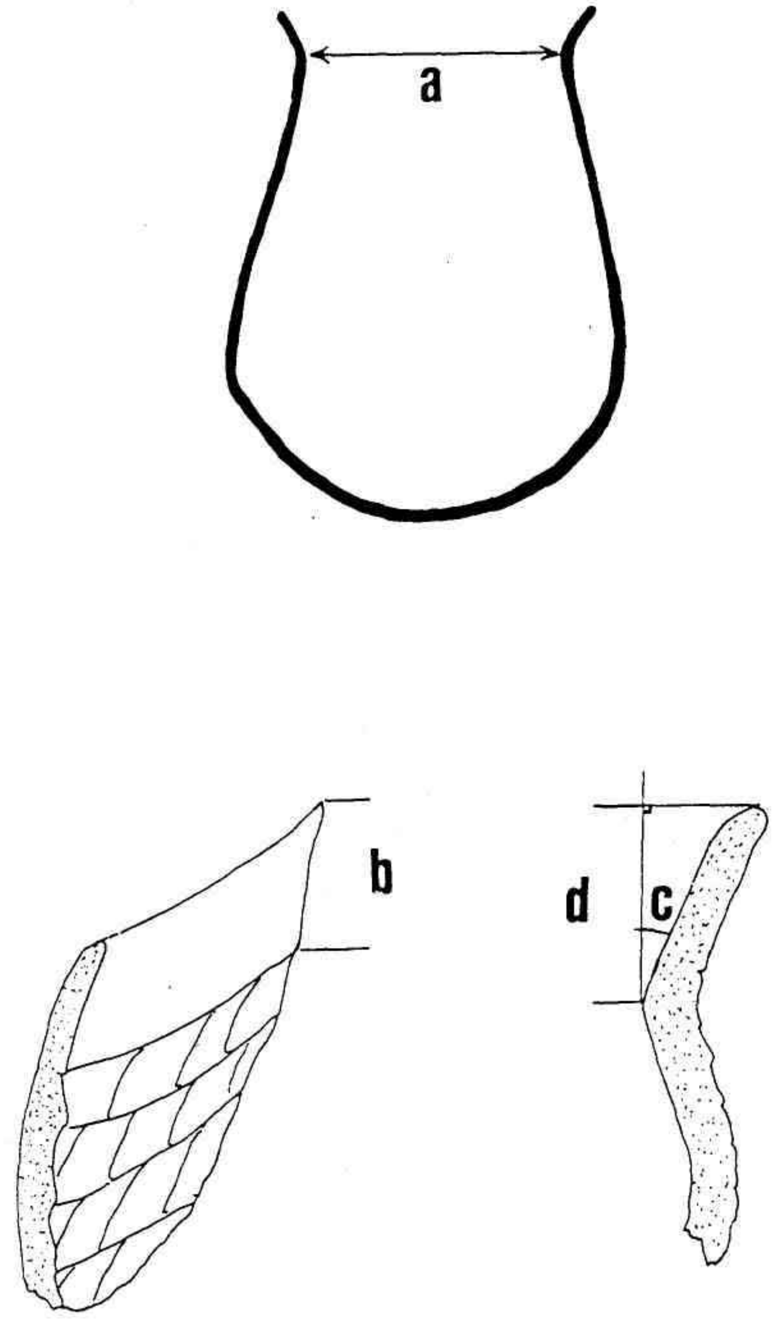

Figure 2.18. Metric variables used in grayware studies: A) orifice diameter shown in cross-section of whole vessel (this measurement is usually estimated from sufficiently large sherds); B) rim fillet width; C) rim flare angle; and D) orifice-to-rim distance.

Table 2.69. *Whole vessel correlations between grayware metric attributes: jars greater than 500 cc.*

	Orifice Diameter	Rim Fillet	Rim Flare	Orifice to Rim	Height
Volume r	.888	.134	-.103	.474	.982
p	.000	.489	.704	.074	.003
n	32	29	16	15	5
Diameter r	-	.101	-.003	.502	.993
p	-	.604	.992	.057	.001
n	-	29	16	15	5
Rim fillet r	-	-	.131	-.073	-.202
p	-	-	.623	.796	.798
n	-	-	17	15	4
Rim flare r	-	-	-	.252	-
p	-	-	-	.364	-
n	-	-	-	15	[1]
Orifice-to-rim no.	-	-	-	-	[1]

	no.	mean	minimum	maximum	CV %
Volume	33	10,010.3	705	21,220	67.2
Rim diameter mm	32	185.2	60	260	30.2
Rim fillet mm	29	16.3	10	34	35.9
Rim flare degrees	16	18.8	11	25	26.6
Orifice-to-rim mm	15	13.1	3	45	80.9
Height MM	5	267.4	131	385	43.0

Pueblo II-III, and Pueblo III Corrugated. The objective measurement of rim flare shows some inconsistency in the application of this attribute to type groups (note the overlap in ranges among types). This inconsistency stems, in part, from typological placements biased by site because all sherds were analyzed in site groups. Grouping sherds by rim flare might have been preferable to using types, but rim flare is not the only classificatory consideration, and type groups have been used.

4) Orifice-to-rim distance. The orifice is defined as the smallest part of the vessel opening rather than the rim itself. In most graywares, the distance from the rim to this constricted orifice is measurable.

The table of whole grayware vessel variable correlations (Table 2.69) shows high correlations between volume and diameter, between volume and height, and between height and diameter (note that very few vessels were measured for height). The other metric variables show little or no relationship to vessel volume, showing again that they probably monitor variability other than vessel size. Most of the sample of whole vessels is Pueblo II Corrugated and earlier (as seen in rim flare mean and range). The vessels are from the same sources as those discussed in the Ceramic Group Definitions (Appendix 2A), but includes only vessels with volumes greater than 500 cc. The whole group contains two vessels smaller than 400 cc in volume, which probably belong in a different functional category.

Because of the nature of the data, the analyses that follow make a number of assumptions. In an effort to minimize repetition of caveats, necessary recognitions are as follows:

1) The analyses are based only on rim attributes, which in turn are based on estimates from sherds. Measurements from entire vessels are far more reliable and more likely to have functional as well as production meaning.

2) The temper discriminations are grosser than desirable and not comparable in comprehensiveness. That is, trachyte is likely to be from a fairly specific location while "sandstone" is from a potentially much larger area. Chalcedonic sandstone is potentially either intermediate or from an area as specific as that for trachyte.

3) Analysis of any sort based on such attributes is extremely preliminary, but if patterning may be found at this crude level, it is suggestive that better controlled studies might well refine and elaborate the patterns discernible.

In using these measurements for assessing variability through time, either singly or in combination, it is, of course, important to know to what extent they are independent. Table 2.70 shows Pearson's correlations within types and indicates the frequency with which pairs of given attributes could be recorded for individual items. On the whole, correlations between measures are quite low; 75 percent are less than 0.3 and all are less than 0.7. Over half are significant, but this stems from relatively large sample sizes and the low values suggest that, in most cases, the attributes are measuring aspects of the pottery that are different enough to be of interest. In all of the types with less flared rims, the highest correlation is between rim flare and the orifice-to-rim distance, including the two largest values of the coefficient (.570 and .655). The orifice-to-rim distance values for these types, especially those prior to Pueblo II Corrugated, tend to be very small as do the rim flare values (Table 2.71B,C). Clearly, as the flare increases, there tends to be a greater (though still small) distance from the rim to the orifice. In the later corrugated types (Pueblo II, Pueblo II-III, Pueblo III), the correlation of orifice-to-rim with rim fillet width is stronger, reflecting the tendency of the point of rim flexure to be at the base of the fillet in these types. It is notable that there is not a stronger negative correlation in Pueblo II-III and Pueblo III types between flare and orifice-to-rim distances because vessels with more everted rims seem likely to have shorter orifice-to-rim distances.

With respect to sample size, it is apparent that rim flare and orifice-to-rim distance are the least often recorded, followed by diameter estimate. Rim fillet width is substantially more often available in every type since it can be measured on almost any corrugated rim sherd (Table 2.70). In most types, the least frequently co-occurring pair of attributes is flare and orifice-to-rim, though flare and diameter attributes are less frequently measured in some cases. The orifice-to-rim measurement was little used in most project analyses because it was assumed to be very close to the fillet measurement. This assumption is not reflected in the correlations, but the distributions and correlations with rim flare make it evident that it is not a useful measurement in the early types and that rim flare is perhaps of questionable value. All of the measurements seem best suited to Pueblo II-III and Pueblo III Corrugated, although the relatively high correlation between orifice-to-rim and fillet width in Pueblo II (r=.53) suggests some redundancy. In the multivariate analyses, only Pueblo II-III Corrugated showed maximum group discrimination when all four rim variables were used, further suggesting that these variables are better suited to some periods than others.

If it could be safely assumed that the point of rim flexure was always at the base of the rim fillet, the three measurements (fillet width, rim flare, and orifice-to-rim distance) would be in a trigonometric relationship. The fillet width would be the hypotenuse length, the orifice-to-rim distance one side, and the flare the angle between the two; however, the fillet-hypotenuse assumption may not be made, and the correlation coefficients show that no simple relationship allowing prediction of one value from another exists. The correlation between fillet and orifice-to-rim is best for Pueblo III Corrugated (r=.53), which is the most everted rim form, showing that the point of flexure in widely flared pots does tend to be at the fillet base, but not in earlier vessels. It is possible that a more complex mathematical relationship exists.

Perusal of coefficients of variation (CV) shows that several categories may be formed using this measure (Table 2.71). Both flare and orifice-to-rim

Table 2.70. Correlations between grayware metric attributes for entire analysis sample.

	Diameter	Fillet	Flare	Orifice to Rim
Wide Neckbanded				
Diameter	[208]	206	149	159
Fillet	.161^a	[243]	154	166
Flare	.095	.003	[154]	148
Orifice-to-rim	.067	-.031	.470^a	[166]
Narrow Neckbanded				
Diameter	[505]	502	298	339
Fillet	.246^a	[571]	307	350
Flare	-.014	.118^a	[308]	305
Orifice-to-rim	.097	.251^a	.656^a	[351]
Neck Corrugated				
Diameter	[174]	174	123	136
Fillet	.187^a	[194]	127	140
Flare	-.201^a	-.089	[127]	123
Orifice-to-rim	.123	.034	.434^a	[140]
PII Corrugated				
Diameter	[875]	869	604	612
Fillet	.293^a	[1005]	622	634
Flare	-.020	.202^a	[622]	605
Orifice-to-rim	.245^a	.422^a	.579^a	[634]
PII-III Corrugated				
Diameter	[211]	209	160	163
Fillet	.202^a	[222]	162	165
Flare	-.182^a	.058	[162]	155
Orifice-to-rim	.308	.255^a	.199^a	[165]
PIII Corrugated				
Diameter	[96]	95	83	85
Fillet	.321^a	[102]	86	88
Flare	-.273^a	-.114	[86]	86
Orifice-to-rim	.357^a	.529^a	-.037	[88]

Table set-up:	[n]	n	n	n
	r	[n]	n	n
	r	r	[n]	n
	r	r	r	[n]

where:
[n] is the number of specimens for which there is a measurement.
n is the number of specimens for which the paired attributes are measured.
r is the Pearson's correlation coefficient between the attributes.
^{a} = r values significant at $<.05$.

have very high values (greater than 40 percent, or even 60 percent) in the earlier types in most or all temper groups. These high values contrast to groups of values in the 20 percent to low 30 percent range in the later types. While these percentages are all considerably greater than those Thomas (1976:84) says indicate inclusion of several biological categories in a sample, it is an index of the usefulness of certain of the measures. On this basis, there is a consistency in all diameter and fillet measurements, except that the CV for rim flare is less than 40 percent only in Pueblo II, Pueblo II-III, and Pueblo III Corrugated

Table 2.71. Grayware rim metrics by type and temper.[a]

Temper Group	No.	Mean cm	Standard Deviation	Range cm	Standard Error	CV %
A. Rim Diameter						
Wide Neckbanded	208	17.6	4.47	7-35	.31	25.4
Sandstone	146	17.7	4.51	7-35	.37	25.5
Chalcedonic sandstone	38	17.8	4.82	9-30.5	.78	27.2
Trachyte	19	17.0	3.86	7-24	.89	22.7
Narrow Neckbanded	505	18.0	5.31	5-35	.24	29.6
Sandstone	287	17.7	5.15	5-35	.30	29.2
Chalcedonic sandstone	72	17.2	5.63	5.5-35	.66	32.7
Trachyte	92	19.7	5.64	7.5-33	.59	28.6
Neck Corrugated	174	18.2	5.29	6.5-35	.40	29.1
Sandstone	93	17.8	5.18	6.5-35	.54	29.1
Chalcedonic sandstone	19	18.4	5.32	8.5-26	1.22	28.9
Trachyte	45	18.1	5.88	9-35	.88	32.5
PII Corrugated	875	21.2	5.54	7-35	.19	26.1
Sandstone	333	20.6	5.36	7-35	.29	26.0
Chalcedonic sandstone	43	21.2	5.46	8-33	.83	25.8
Trachyte	283	21.7	5.29	7-35	.31	24.4
Trachyte+sandstone	29	22.0	5.64	8-35	1.05	25.6
PII-III Corrugated	211	21.3	5.46	7-35	.38	25.6
Sandstone	85	20.2	5.39	7-32	.58	26.7
Trachyte	89	22.5	5.51	8-35	.58	24.5
PIII Corrugated	96	16.7	5.59	7-33	.57	33.6
Sandstone	49	15.8	5.16	7-33	.74	32.6
Trachyte	22	20.1	5.55	9-33	1.18	27.6
B. Rim Fillet Width						
Wide Neckbanded	243	16.4	3.36	9-29	.22	20.4
Sandstone	164	16.5	3.18	10-29	.25	19.3
Chalcedonic sandstone	47	16.3	3.63	9-26	.53	22.3
Trachyte	25	16.4	4.21	10-28	.84	25.6
Narrow Neckbanded	571	15.6	4.03	6-42	.17	25.8
Sandstone	327	15.0	3.81	7-33	.21	25.4
Chalcedonic sandstone	79	15.9	3.21	9-24	.36	20.2
Trachyte	104	16.3	3.96	6-25	.39	24.4
Neck Corrugated	194	14.3	3.59	6-27	.26	25.1
Sandstone	108	14.1	3.65	7-27	.35	25.8
Chalcedonic sandstone	21	15.2	3.86	8-22	.84	25.3
Trachyte	48	14.1	3.55	6-22	.51	25.1
PII Corrugated	1,005	21.8	6.20	8-53	.20	28.5
Sandstone	401	23.8	7.04	10-53	.35	29.6
Chalcedonic sandstone	51	21.8	6.39	10-38	.90	29.3
Trachyte	332	20.2	4.61	10-38	.25	22.9
Trachyte+sandstone	29	20.1	4.25	13-30	.79	21.2
PII-III Corrugated	222	22.4	6.76	6-50	.45	30.2
Sandstone	91	24.3	8.33	7-50	.87	34.3
Trachyte	92	20.9	4.65	6-37	.48	22.2
PIII Corrugated	102	19.7	6.42	6-37	.64	32.6
Sandstone	54	18.8	6.30	6-34	.86	33.5
Trachyte	23	21.2	6.41	6-30	1.34	30.2

Table 2.71. (continued)

Temper Group	No.	Mean cm	Standard Deviation	Range cm	Standard Error	CV %
C. Rim Flare						
Wide Neckbanded	154	18.1	7.91	2-45	.64	43.6
Sandstone	106	17.9	7.44	2-45	.72	41.6
Chalcedonic sandstone	31	20.4	9.60	6-45	1.72	47.0
Trachyte	12	16.3	6.93	7-27	2.00	42.4
Narrow Neckbanded	311	18.5	7.88	4-42	.45	42.6
Sandstone	181	18.6	8.14	4-42	.60	43.7
Chalcedonic sandstone	43	16.4	7.75	5-41	1.18	47.1
Trachyte	56	18.0	6.99	5-34	.93	38.9
Neck Corrugated	127	19.7	8.18	5-41	.73	41.4
Sandstone	68	21.4	8.41	5-41	1.02	39.3
Chalcedonic sandstone	13	12.8	7.41	6-31	2.06	57.7
Trachyte	32	19.4	7.55	6-37	1.33	38.8
PII Corrugated	622	25.4	7.60	5-49	.30	29.9
Sandstone	231	27.0	7.66	5-49	.50	28.4
Chalcedonic sandstone	29	21.4	8.93	9-40	1.66	41.8
Trachyte	210	25.6	7.47	6-45	.52	29.2
Trachyte+sandstone	16	24.9	6.93	8-35	1.73	27.8
PII-III Corrugated	162	33.9	6.98	12-57	.55	20.6
Sandstone	69	35.5	7.84	12-57	.94	22.1
Trachyte	68	32.4	6.02	15-43	.73	18.6
PIII Corrugated	86	42.5	8.01	22-65	.86	18.8
Sandstone	43	42.4	8.84	22-63	1.35	20.8
Trachyte	22	41.1	6.92	25-52	1.48	16.8
D. Orifice to Rim Distance						
Wide Neckbanded	166	5.6	3.16	1-17	.24	56.6
Sandstone	117	5.9	3.28	1-17	.30	55.8
Chalcedonic sandstone	31	5.1	2.66	1-11	.48	52.2
Trachyte	13	4.4	3.02	1-11	.84	68.8
Narrow Neckbanded	351	5.9	3.90	1-28	.21	65.7
Sandstone	208	6.0	3.92	1-23	.27	65.8
Chalcedonic sandstone	52	5.2	4.27	1-28	.59	82.6
Trachyte	58	5.8	3.45	1-15	.45	59.9
Neck Corrugated	140	7.4	6.00	1-45	.51	81.2
Sandstone	78	7.9	5.12	1-32	.58	64.6
Chalcedonic sandstone	15	4.5	4.45	1-18	1.15	98.2
Trachyte	32	6.8	5.72	1-25	1.01	84.0
PII Corrugated	634	13.0	7.14	1-45	.28	54.8
Sandstone	237	14.3	7.17	1-45	.47	50.0
Chalcedonic sandstone	32	9.8	7.76	1-28	1.37	78.8
Trachyte	212	13.5	7.36	1-45	.51	54.7
Trachyte+sandstone	18	12.9	6.61	1-28	1.56	51.1
PII-III Corrugated	165	16.1	5.68	5-40	.44	35.3
Sandstone	70	15.8	5.62	6-30	.67	35.5
Trachyte	69	16.5	6.13	5-40	.74	37.1
PIII Corrugated	88	16.8	6.35	1-35	.68	37.8
Sandstone	44	15.4	5.92	1-33	.89	38.4
Trachyte	22	19.4	6.14	9-31	1.31	31.7

* Only jars and only groups of ten or more are included.

and that the orifice-to-rim distance CV is less than 40 percent only in Pueblo II-III and Pueblo III Corrugated.

There are a number of cases in the earlier types with rim flare measurements that are outside the "normative" range of values; that is, these earlier vessels on the whole tend to have vertical walls with little flexure near the rim. The small percentage showing greater rim flare may be the result of some or all of the following: attempting to measure sherds smaller than the minimum size required for accurate flare readings, coding error, typological assignment inconsistencies, or real variability. Removal of cases considered extreme would obviously reduce the observed variability, but lacking a case-by-case reassessment, the items have been left in the analyses.

Simple Variability in Graywares—Modality and Variation. Because of the complications involved with statistically testing variance in samples of different size, the descriptive statistics for the variables used are first discussed on their own merits. Levels of significance and contribution to explanation will be found in the multivariate section. Examination of variability in an attribute at a time promotes a more fundamental understanding of the data before launching into the mysteries of multivariate space. The primary means of comparison here is the coefficient of variation (CV), which expresses the relationship of the standard deviation to the mean as a percent. Longacre et al. (1988) also used CV in their study of ceramic standardization. In a later study, Longacre and his colleagues (Kvamme et al. 1996), argue that distributions should be tested for normality and that, in the likely event that the distribution is not normal, statistical techniques designed to account for non-normality should be used; such corrections have not been employed here.

With increases in architectural complexity and population size, more and more specialization in various roles within the Chaco region is likely until sometime in the early A.D. 1100s. If specialization developed in the system, and if standardization is a valid expectation with this level of specialization, there should be reduced variability in at least some production groups through the Pueblo II-III part of the ceramic sequence in Chaco Canyon.

Rice (1981) and others suggest that specialized producers may also be manifested in their products as modes in distributions, with modes representing distinctive producers. If there were marked standardization of vessel sizes, it should appear as modes in diameters, although functional size groups are likely to be present as well (Longacre et al. 1988). Modality is a statistic that is often invoked but rarely well defined. In many archeological samples (especially the smaller ones), there are numerous "peaks" in a distribution, and distributions containing two major peaks of identical size are rare.

Because it is based both on frequency cutoffs and interval definition, recognizing "multimodality" is, therefore, somewhat subjective and arbitrary. Table 2.72 summarizes a series of frequency plots by showing the number of peaks above cutoffs of 10, 15 and 20 percent. A "peak" is defined here as a point at which there is a higher percentage than in either of the adjacent intervals. Thus, a normal distribution has only one peak, but the more usual, less smooth archeological curve has several, depending on cutoff level. All of the frequency distributions use groups of measurements, and the manner in which data are grouped is clearly critical to the final appearance of the graphs. The groups used are sufficiently large to produce lines with some definition of trends. The groups represent physical size increments that are quite small. For diameter estimates, four measurements representing a total of 1.5 cm are grouped (e.g., 17.0, 17.5, 18.0, 18.5 cm). Fillet widths and orifice-to-rim distances have been grouped into 3 mm groups (e.g., 8, 9, 10 mm). Rim flare was placed in 3° groups (e.g., 7°, 8°, 9°). The column labelled "Intervals ≥15%" shows the number of points at or above 15 percent, which gives an idea of distribution shape. Fifteen percent was chosen as a cutoff because several distributions contain no intervals of 20 percent, while many types contain numerous intervals greater than 10 percent. Only type-temper groups containing samples of at least 20 are included.

Rim Diameters. The only metric variable which can be compared for all the graywares is the estimated rim diameter. Diameter is, to some degree, correlated with size, which in turn, relates to function. Because it is virtually assured that grayware jars were intended for a variety of functions throughout the sequence, variability is expectable

Table 2.72. *Distribution summary for Chaco grayware metric attributes showing number of peaks at various cutoff percentages and number of points above 10% and 15% where type and type-temper samples are 20 or more.*

	Rim Diameter					Rim Fillet					Rim Flare					Rim to Orifice				
	Peaks ≥			Points ≥		Peaks ≥			Points ≥		Peaks ≥			Points ≥		Peaks ≥			Points ≥	
	10	15	20%	10	15%	10	15	20%	10	15%	10	15	20%	10	15%	10	15	20%	10	15%
Wide Neckbanded	2	1	1	5	2	1	1	1	4	2	1	1	0	5	2	1	1	1[a]	4	3
Sandstone	1	1	1	5	2	1	1	1	4	2	-	-	-	-	-	-	-	-	-	-
Chalcedonic sandstone	3	2	2	5	2	1	1	1	4	2	-	-	-	-	-	-	-	-	-	-
Narrow Neckbanded	1	1	0	5	1	2	1	1	4	2	2	1	0	4	1	1	1	1[a]	4	3
Sandstone	1	1	0	5	2	1	1	1	5	2	-	-	-	-	-	-	-	-	-	-
Chalcedonic sandstone	2	2	1	4	2	1	1	1	4	3	-	-	-	-	-	-	-	-	-	-
Trachyte	2	2	0	4	2	2	2	2	4	3	-	-	-	-	-	-	-	-	-	-
Neck Corrugated	3	1	0	5	1	1	1	1	4	2	2	2	0	4	2	1	1	1[a]	3	3
Sandstone	3	2	0	5	3	1	1	1	4	2	-	-	-	-	-	-	-	-	-	-
Chalcedonic sandstone	[3	2	1	5	4][b]	3	3	1	4	3	-	-	-	-	-	-	-	-	-	-
Trachyte	2	2	0	4	2	1	1	1	4	2	-	-	-	-	-	-	-	-	-	-
PII Corrugated	1	1	0	5	1	1	1	1	4	2	1	1	0	4	2	1	1	0	4	2
Sandstone	1	0	0	4	0	1	1	1	6	1	2	1	0	4	2	2	2	0	4	3
Chalcedonic sandstone	1	1	0	4	2	1	1	1	3	3	3	0	0	5	0	2	2	1	3	3
Trachyte	2	1	0	4	2	1	1	1	4	2	2	1	1	6	2	2	2	0	6	2
Trachyte + sandstone	3	3	1	4	3	1	1	1	4	3	*	*	*	*	*	*	*	*	*	*
PII-III Corrugated	1	1	0	5	2	2	1	1	4	1	3	1	0	5	3	1	1	1	4	3
Sandstone	2	1	1	4	1	2	1	1	3	1	2	1	1	6	1	1	1	1	4	3
Trachyte	3	1	0	5	1	1	1	1	3	1	3	2	0	5	4	1	1	1	4	2
PIII Corrugated	2	1	0	5	2	3	3	1	5	3	2	1	1	3	2	2	2	2	4	3
Sandstone	2	2	0	4	3	3	2	1	5	2	2	2	1	4	3	2	2	2	4	3
Trachyte	2	2	1	5	2	2	2	1	4	3	2	2	1	4	2	1	1	1	4	2

* n < 20.

[a] heavily skewed left.

[b] [] n = 19.

For n's, see Table 2.73 A, D.

in all time periods.

There are sufficient numbers of Lino Gray jars and tecomates to consider both forms here; further subdivisions are also possible. There are several classes of sandstone temper that were provisionally recorded for Lino, as well as the surface treatments fugitive red (Lino Fugitive) and polished (Obelisk Gray). With these subdivisions, the "Lino" group is more finely divided by both temper and form than are any of the subsequent groups. This unequal treatment has the advantage of maximizing the chance that groups with low variability will be encountered in this earliest group. Sandstone tempers constitute the great majority of all the Lino pottery in the collection, and figures for sandstones treated as in the later types are also given in Table 2.73 as "lumped sandstone."

The coefficient of variation values for the ten Lino groups are quite erratic, ranging from 24.7 percent to 40.1 percent. The frequency distributions for these groups are quite uniformly smooth curves, with one major peak at 8 to 10 cm and a tail to the right, beginning around 14 cm. At face value, the combination of relatively high variability and single peak curves suggests numerous producers making vessels within a fairly specific size range. There are several notable aspects of these diameter distributions:

1) Compared to actual diameters of later types, the Lino diameters look very small. The means are around half those of the later types and the upper end of the Lino ranges are less than some of the later means. This does not, however, mean that there were no large vessels during the period when Lino was used. The tecomate form, which constitutes 61 percent of the items shown in Table 2.73A, has a different orifice-size relationship than later gray jars because of the necessary constriction of the orifice (Figure 2A.1). The correlation between orifice diameter and volume is surely less than that for corrugated jars, but measurable examples are few. The Chaco Project assemblage contains few whole Lino vessels, but the volumes from a tecomate (13,880 cc) and two jars (17,370 and 19,490 cc) are in the range of substantial corrugated jars, although not as large as the largest, which reach 25,000 cc or more. While there are forms similar to later gray forms (e.g., Roberts 1929:111, 29d), many have long necks, more akin in form to later whiteware "ollas" than to later grayware jars; thus, they also have different, probably less direct relationships between orifice and volume.

2) The large coefficients of variation for these groups relates, in part, to the smaller means, but also presumably signify greater variability. It is notable that several of the subdivisions shown in Table 2.73A show lower CV values, suggesting that these groups may represent more specific functional and/or production groups. The largest samples with relatively lower CV values are surface treatment groups—Lino Fugitive jars and polished tecomates. While the "Gallup Sandstone" tempered tecomates is a relatively large group with a low CV, the Gallup Sandstone jars (n=10) have the highest CV of any group. The "Ojo Alamo Sandstone" tempered jars show the smallest CV of any group (with a sample of only 16), while the large group of tecomates (n=41) is more variable. The pattern of variability in these two provisional temper groups is, therefore, reversed. Opposing interpretations of this pattern are possible. On the one hand, it could be suggested that each temper does represent a production area and that the "Gallup Sandstone" temper users specialized in tecomates, while the "Ojo Alamo Sandstone" users produced jars; this is supported, in part, by the presence of a small number of apparently highly variable Gallup Sandstone-tempered jars. On the other hand, the mixed variability may be merely the result of sample sizes, indicating that variability is not predictable on these bases. The relative numbers of vessels in groups, in part, support the interpretation that different groups are represented. There are more Ojo Alamo tecomates than jars with Ojo Alamo or than tecomates with Gallup temper. Blaming the pattern on sample size is the more conservative and most easily supported interpretation. Intermediate to these interpretations is the suggestion that there was some temper selection according to intended vessel function so that the same potter might have produced vessels falling into different temper groups. The number of uncontrolled variables show that a simple explanation is once again liable to be, at best, only a partially accurate one. These data are obviously insufficient basis for any conclusion, but their importance is that they do constitute a suggestion of

Table 2.73. Lino and Obelisk Gray jar and tecomate diameters by type and temper group.

A. Means groups of 10 or more only.

Type-form Overall/ Temper Group	No.	Mean cm	Standard Deviation	Range cm	Standard Error	CV %
Lino Jars	143	9.4	3.50	2.5-23	.29	37.0
Sandstone	74	9.5	3.82	3.5-23	.44	40.1
"Ojo Alamo" sandstone	16	8.9	2.02	4.5-12	.50	22.6
"Gallup" sandstone	10	8.5	3.70	5-18	1.17	43.5
Iron oxide sandstone	16	9.8	3.04	6-17	.76	31.2
Lumped sandstone	106	9.3	3.50	3.5-23	.34	37.7
Lino Fugitive Jars	28	8.1	2.02	4-12	.38	25.0
Undifferentiated sandstone	11	8.6	2.11	5.5-12	.66	24.4
Lumped sandstone	26	8.2	2.00	4-12	.39	24.4
Obelisk Jars	12	8.0	2.61	4.5-13	.75	32.6
Lino Tecomates	257	9.9	3.23	2.5-21	.20	32.6
Undifferentiated sandstone	127	9.6	3.21	2.5-19	.29	33.5
"Ojo Alamo" sandstone	41	10.1	3.24	4.5-18	.51	32.1
"Gallup" sandstone	34	10.8	2.67	5.5-19	.46	24.7
Iron oxide sandstone	29	10.6	4.13	5-21	.78	39.0
Lumped sandstone	212	9.9	3.13	2.5-19	.21	31.8
Obelisk Tecomates	34	8.8	2.18	5.5-15	.37	24.7
Undifferentiated sandstone	27	9.1	2.26	5.5-15	.44	24.8

B. Diameter distribution summary (modes); groups of 20 or more only.

Temper Group	Peaks ≥			Points ≥	
	10	15	20%	10	15%
Lino Jars	1	1	1	4	3
Sandstone	1	1	1	3	3
Lumped sandstone	1	1	1	3	2
Lino Fugitive Jars	1	1	1	4	2
Lino Tecomates	1	1	1	4	3
Sandstone	1	1	1	4	3
"Ojo Alamo" sandstone	1	1	1	3	3
"Gallup" sandstone	2	2	1	3	2
Iron oxide sandstone	1	1	1	5	2
Lumped sandstone	1	1	1	4	3
Obelisk Tecomates	3	2	2	3	2
Sandstone	1	1	1	3	2

"Lumped sandstone" is the combination of undifferentiated. "Ojo Alamo," "Gallup," and other sandstones later coded as undifferentiated (does not include iron oxide).

CV % values in A are calculated with means and deviation values with greater precision than those shown.

some production differentiation in the earliest phases of ceramic production in the Chaco region.

Using the Lino variety values as a baseline, it can be seen that the variability in subsequent types' diameters is consistently, but never dramatically, less, and considerably less erratic (Table 2.71A). Remembering that the CV extremes on the table form a tight range from 22.7 percent to 33.6 percent, some trends may be noted. Importantly, the earliest type, wide neckbanded, has the overall the lowest orifice diameter variation, followed by higher variation of a similar magnitude in the two subsequent neck-decorated types. The two types concurrent with the system's peak, Pueblo II and Pueblo II-III Corrugated, both show reduced variability, with the latter type showing the least variability since wide neckbanded. The latest and least well-represented corrugated type, Pueblo III Corrugated, has the highest CV values. Within all but one of the type groups (neck-corrugated) the trachyte subset has the smallest CV for the type. The difference is usually a question of a percentage point or two. What seems most significant about the trends, both through time and among tempers, is their consistency rather than the size of the differences. Another consistent feature of the trachyte-tempered portions of narrow neckbanded and later corrugated types is that they all have the largest mean in the type by 1.5 to 2 cm. In both wide neckbanded and neck-corrugated, the temper group means are all quite similar, but chalcedonic sandstone is the largest in both. As previously discussed, this consistency is not apparent in the Lino groups.

Thus far, only the summary characteristics of the component groups have been discussed, which, of course, may easily mask relevant aspects of the actual distributions, particularly if there are multiple modes. Generally speaking, the larger the sample of estimated diameters, the more nearly normal the curve looks. On one level, this is pure statistical expectation for a random population. On the production level, the normal distribution argues against there being either discrete producers or consistent functional groups. As can be seen from the summary distribution table (Table 2.72; also Figure 2.19), the diameter distributions tend to have several low and one moderate (15 to 20 percent) peak. There are a few distributions that tend toward multimodality; the most consistent type in this regard is neck-corrugated, with peaks in all tempers at 9 to 12.5 cm, 17 to 20.5 cm, and 23 to 26.5 cm (Figure 2.19B). Among tempers, chalcedonic sandstone in each of the three earlier types shows a tendency toward several size modes, but the samples of this temper are never as large as might be wished for this purpose.

Rim Fillet Width. This variable is far more consistent in the three earlier types (excluding Lino) than is rim diameter, as can be seen both in the distribution summary and the CV values, but as variable or more so in the three later types (Table 2.71B and 2.72; Figure 2.20). Some of the patterns discussed for diameters recur in the fillet character-istics in spite of the maximum correlation of .32 between these two measures (Table 2.70). The three neck-decorated types are statistically similar and smaller than the three overall corrugated types. Pueblo II and Pueblo II-III Corrugated are very similar in fillet width distribution, and Pueblo III Corrugated is similar but contains more cases with narrower fillets. Once again, the within-type differences in variation are slight and the least variable temper group is inconsistent in the three earlier types. Trachyte-tempered Pueblo II, Pueblo II-III and Pueblo III Corrugated, however, again have the smallest CV's for each type, substantially so for Pueblo II and Pueblo II-III. As is also true in the diameter distributions, the Pueblo II trachyte and trachyte and sandstone groups are very similar, suggesting that the distinction may not be separating production groups. In terms of actual size, each set of type means is quite consistent, although the trachyte examples are smallest in half of the types. There is a gradual decrease from wide neckbanded through neck-corrugated, with a major increase in mean beginning with Pueblo II Corrugated.

Most of the fillet width frequency plots have high, single peaks. The two neckbanded distributions are remarkably similar, as are those for Pueblo II and Pueblo II-III Corrugated. In the pre-Pueblo III Corrugated types the two minor exceptions to this apparent uniformity are in narrow neckbanded trachyte (two "peaks" around 25 percent at 14 to 16 mm and 19 to 22 mm), and the smaller chalcedonic sandstone neck-corrugated sample (n=21, lesser peaks on either side of a 52 percent peak at 14 to 16 mm). The comparatively erratic Pueblo III Corrugated group is smaller, but suggests several modes overall, with two for trachyte and three for sandstone. Both the greater variability and the more jagged frequency plots are, perhaps, most significant in that they repeat the pattern of the Pueblo III Corrugated rim diameter statistics.

Rim Flare. As discussed above, there is so much variability in rim flare and orifice-to-rim distances in wide and narrow neckbanded and neck-corrugated as to make them suspect measurements for these types. The rim eversion

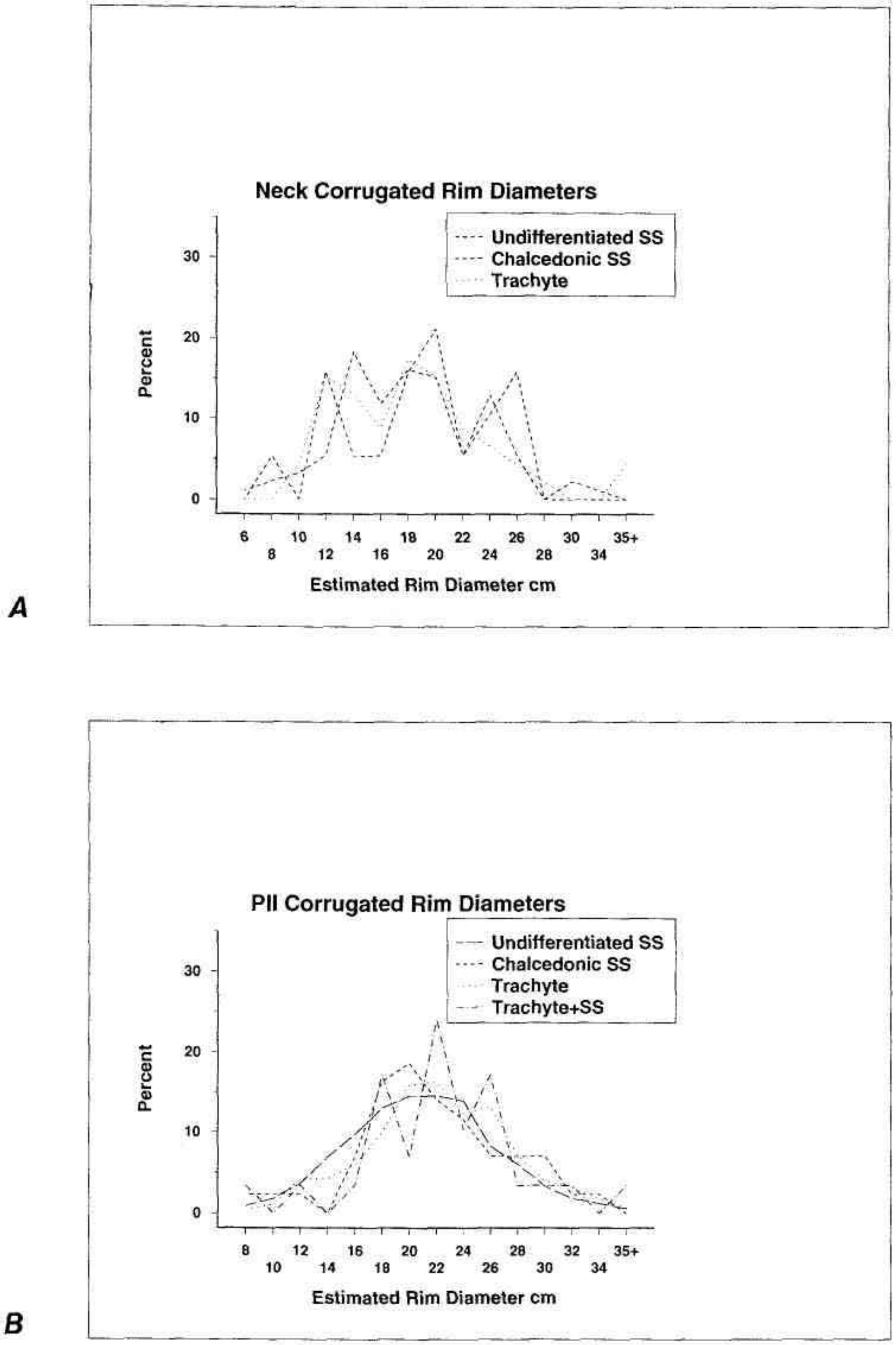

Figure 2.19. Frequency distributions for grayware jar orifice diameters of A) neck-corrugated (overall n=160, group n range 19 to 93), and B) Pueblo II Corrugated by major temper type (overall n is 606, range 29 to 331).

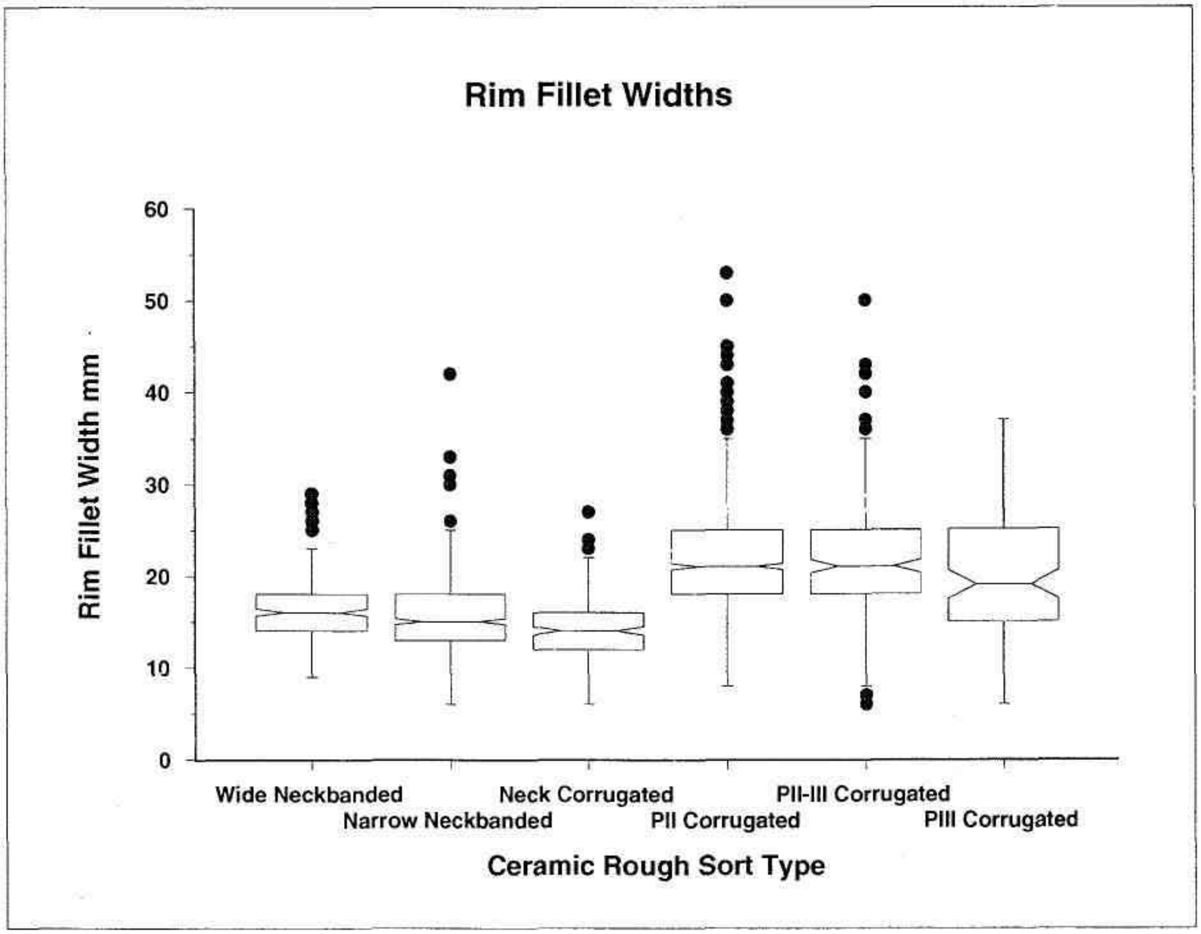

Figure 2.20. Box plot of rim fillet widths in types with fillets. Only jars are shown, counts are:

Wide Neckbanded	*242*
Narrow Neckbanded	*571*
Neck Corrugated	*194*
Pueblo II Corrugated	*1,005*
Pueblo II-III Corrugated	*222*
Pueblo III Corrugated	*102*

In notched box plots the box top and bottom lines represent the interquartile range (25 to 75 percent), the line within the box is at the median; if the notches of two boxes do not overlap, there is a 95 percent chance that the samples are different on the measurement in question (Chambers et al. 1983:60-63). Range of values is shown by lines outside boxes, extremes and [statistical] outliers are plotted individually.

measurements for the three types have several things in common: 1) the mean flare for these three types increases very slightly through time; 2) all three distributions are skewed left; and 3) narrow neckbanded and neck-corrugated show erratic tails to the right, each with a peak at 22° to 24°. The transitional nature of Pueblo II Corrugated is suggested by its single peak at 22° to 24° and its closer approximation to normal, due to the presence of far more items to the right. Pueblo II Corrugated is closer to narrow neckbanded and neck-corrugated than to Pueblo II-III Corrugated, although there is little overlap between the neck decorated types and Pueblo II-III Corrugated and considerable Pueblo II-Pueblo II-III overlap. The overlap between Pueblo II Corrugated and Pueblo III Corrugated is less than that between narrow neckbanded and Pueblo II-III. Figure 2.21 shows the progressively greater rim flare in corrugated types by smoothing the internal variability into 10° groups.

The two major Pueblo II Corrugated temper groups, sandstone and trachyte, are very similar to the overall distribution and to one another. The chalcedonic sandstone group is small (n=28), but its distribution is much more similar in mean, variation, and frequency distribution to those of the earlier types than to the rest of Pueblo II Corrugated. This similarity is not present in the diameter and rim fillet measures, but is present in the orifice-to-rim distance (flare and orifice-to-rim are relatively highly correlated in Pueblo II Corrugated; r=.57). Because this temper reaches its highest relative frequencies before Pueblo II Corrugated in the Chaco sequence, these metric similarities with earlier types suggest two possibilities: 1) the bulk of the chalcedonic Pueblo II Corrugated is temporally early Pueblo II Corrugated; and 2) the producers of chalcedonic sandstone-tempered pottery were more conservative than others in the system. In view of the abundance of this temper in earlier contexts, the former seems more likely, but absolute dating of the pottery is the only true (if absent) arbiter.

The consistency of rim flare measures in Pueblo II-III and Pueblo III Corrugated stands in marked contrast to the preceding types. This stems in large part, of course, from the fact that rim flare is the primary criterion for identifying these types, making the cultural implications unclear. Flare does correlate with context and time (Figure 2.21; Rohn 1971:130-141; Toll and McKenna 1987:117-125), further muddying the production picture. Once again, however, within the "types" used here, temper should vary independently. In both Pueblo II-III and Pueblo III, the trachyte CVs are less than those of sandstone, repeating the pattern from diameter and fillet width. In both types, the trachyte mean is somewhat less than the sandstone mean, suggesting a metrically distinctive, but on the whole, similar production group. Both of the Pueblo II-III temper plots are rather broad and flat, while especially the sandstone Pueblo III plot is more markedly peaked.

Orifice-to-rim Distance. The strongest between-measure correlations in the types wide neckbanded through Pueblo II Corrugated are between rim flare and orifice-to-rim distance (Table 2.70). The orifice-to-rim distributions (Figure 2.22) for all these types are heavily skewed left with a substantial tail only in Pueblo II Corrugated. Through Pueblo II Corrugated, various tempers show the least variability with little patterning apparent except perhaps, for relatively large variation in chalcedonic sandstone; although this, too, is violated in wide neckbanded. Unlike the other three measures, the sandstone-tempered segments are the least variable in three of the six types. Whereas trachyte was the least variable group in the late types in the other metric variables, trachyte has the lowest CV only in Pueblo III Corrugated for orifice-to-rim distance. The difference in Pueblo III is quite visible in the frequency plots in the striking bimodality of the sandstone group at 10 mm to 12 mm and 16 mm to 21 mm (trachyte shows a single peak at 19 mm to 21 mm). The Pueblo II-III plots are much more regular with both trachyte and sandstone nearly identical in shape. The capricious behavior of this attribute, relative to the others, makes it difficult to interpret.

Univariate Summary. Figure 2.23 shows the coefficient of variation for each metric variable for whole types, lumped undifferentiated sandstone, and trachyte, arranged in typological time sequence (based on the data in Table 2.71). The lack of formal comparability between the predominant early (Lino) forms and the subsequent corrugated forms complicates discussion of temporal trends. In terms of sheer variability, the Lino vessel diameters show, on the whole, more variation than do the later ones,

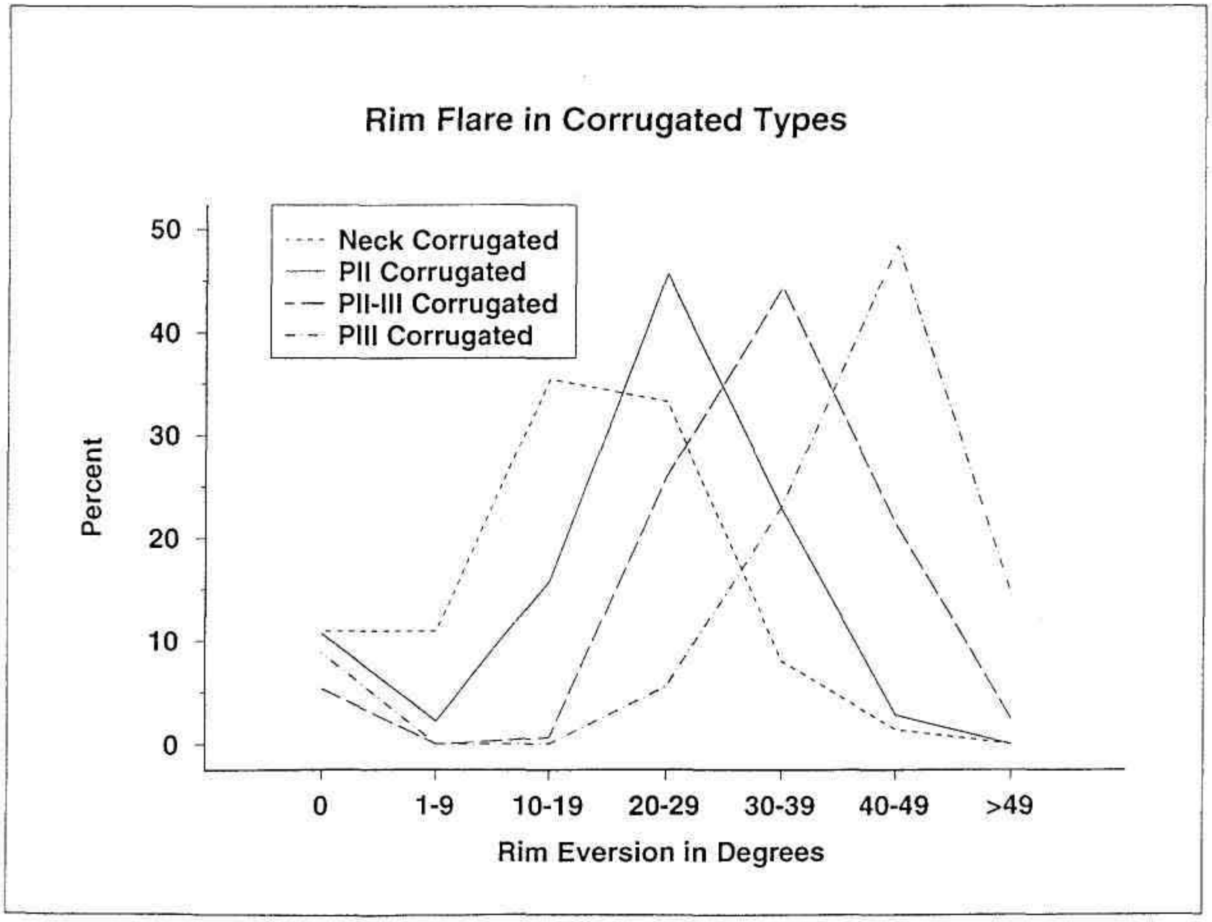

Figure 2.21. Rim flare distribution for four corrugated types. Rim flares are in 10 mm groups plus zero. Cases shown are those large enough to permit estimation of orifice diameter.

in spite of the likelihood that functional variability is probably more directly visible in later diameters than in Lino orifice diameters. The "jar" form category in Lino that is likely to contain more variety of forms is "jar" in the corrugated types. Lino tecomates, however, while subject to a size range (as are corrugated jars), are probably as formally consistent as corrugated jars. Even the tecomates have higher CV values than the later types, although the tecomate CVs are in the upper corrugated range.

Compared to the other measurements, the variation in diameter is the most constant, probably because of the relationship between diameter and function (Figure 2.23). The least variation on all variables is in Pueblo II-III Corrugated, although on all but orifice-to-rim distance Pueblo II Corrugated is quite similar. This lower level of variability is of interest because it is at this time period when, on other grounds, specialized production is most likely to have existed in the system and this evidence tends to support that argument for ceramics. The steady reductions in rim flare and orifice-to-rim distance relate to type definition as well as to ceramic variability and should be viewed accordingly. Two types are notable for showing somewhat more variability than adjacent types—neck-corrugated and Pueblo III Corrugated. The degree of increase in

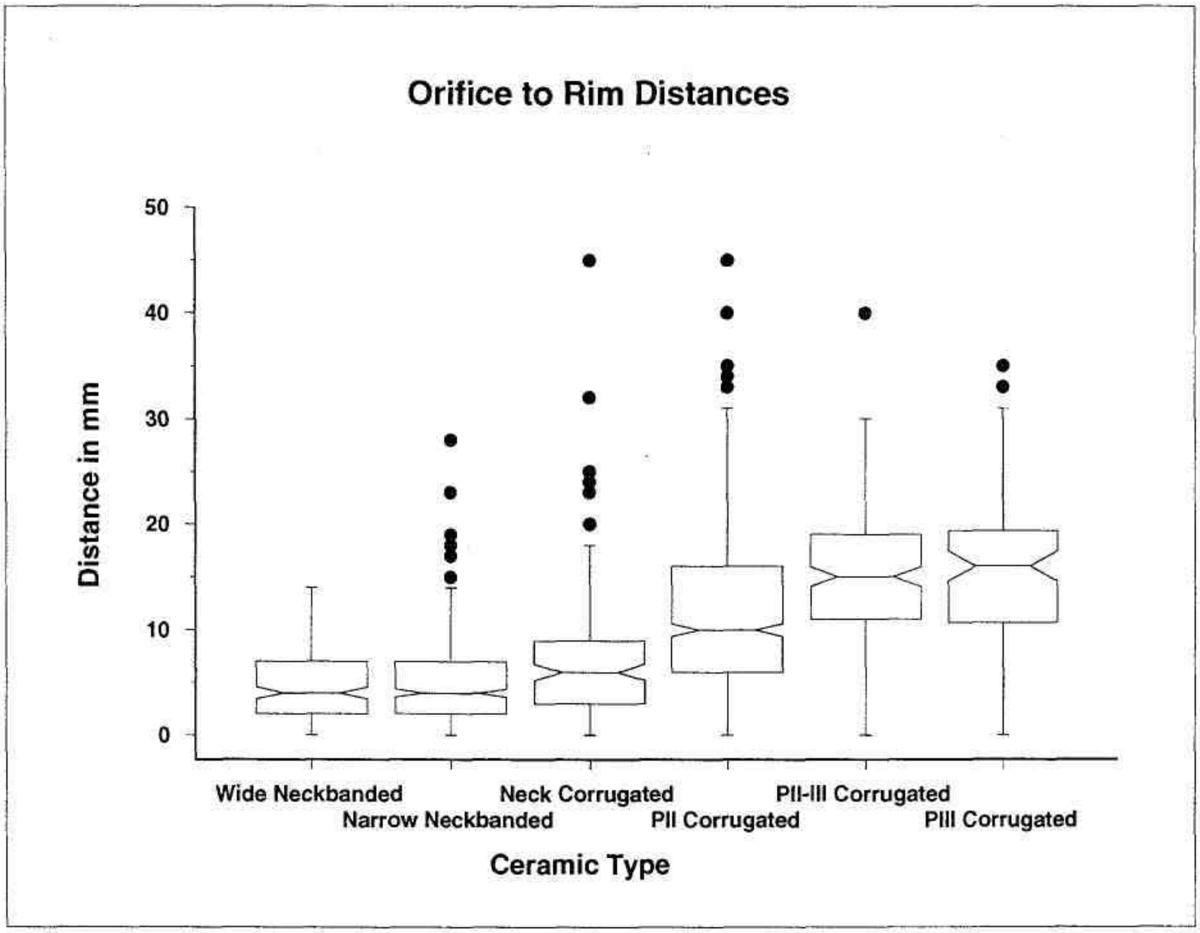

Figure 2.22. Notched box plot of orifice-to-rim distance by type; only jars with estimated rim diameters are shown. Counts for each type are:

Wide Neckbanded	*207*
Narrow Neckbanded	*505*
Neck Corrugated	*175*
PII Corrugated	*875*
PII-III Corrugated	*211*
PIII Corrugated	*96*

variation in overall neck-corrugated is slight, but it is more marked in the trachyte-tempered segment (Figure 2.23B). The neck-corrugated type embodies a number of changes, most notably surface manipulation. Oxidation tests also suggest that there may be changes in the Chuskan Grayware clay source at about the time of neck-corrugated production (Toll and McKenna 1987:186-189), and these various transactions may contribute to the variation seen in trachyte-tempered neck-corrugated. The upturn in variation in the Pueblo III variables is attributable to three causes: sample size, increased variability in

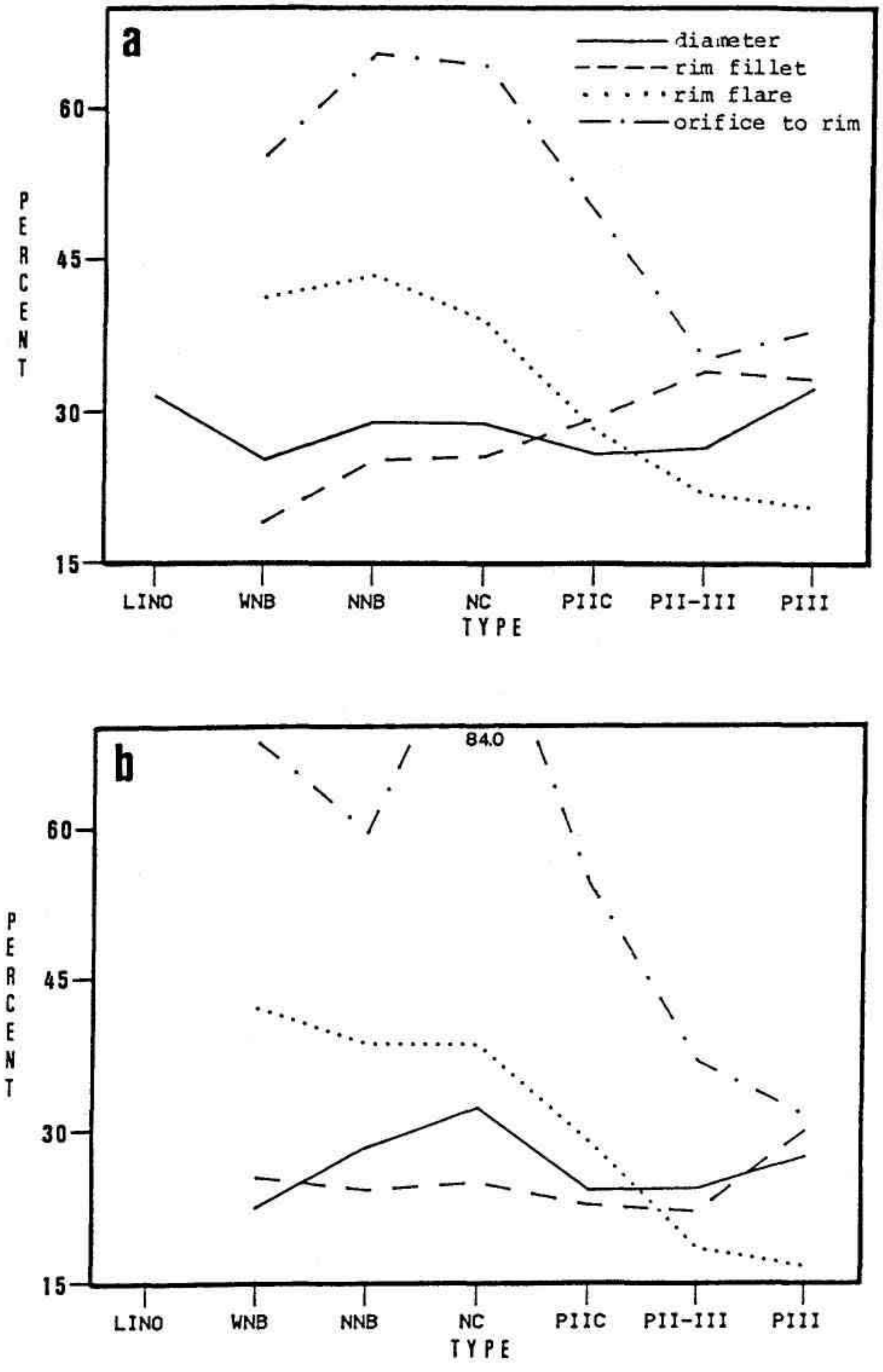

Figure 2.23. Coefficient of variation summaries for A) sandstone temper, and B) trachyte temper, by chronologically arranged type.

context, and time span relative to other types; most interestingly, the likelihood is that at least part of Pueblo III Corrugated was produced under different conditions than Pueblo II and Pueblo II-III Corrugated (Toll et al. 1980). The suggestion of increased variability in Pueblo III Corrugated lends confidence to the utility of the variables for seeing cultural change.

The comparison of the two most abundant tempers (Figure 2.23), shows very similar overall CV trends in all attributes. With the neck-corrugated exception noted above, trachyte groups have less variation than sandstone groups. This is attributable to a more specific source—on the whole, probably longer transport, and also to presumably fewer producers. The trend in fillet variation is especially interesting in that while the overall sandstone trends for the focal Pueblo II and Pueblo II-III periods show increase, the trachyte coefficients decrease. The presence of somewhat less variability in the trachyte-tempered groups, in the context of similarity of change and form over a long time period, may be interpreted as showing an increase in production and transport by a particular group of producers; nonetheless, they continued to work within a set of production practices that was not radically altered from that of their contemporaries or predecessors.

Summarization of modality is more difficult because the meaning of modes is hard to specify. On the one hand, a single strong peak in a distribution may suggest reduced variability and specialists; on the other hand, if most pots fall into a single group, perhaps the requirements of a successful pot are such that everyone makes pots and they all do so according to the same specifications. Many modes among different groups are subject to similar double-edged interpretation. The many modes may show many non-specialized producers making pots erratically or they may represent distinctive specialized production. Distinctiveness of interval and consistency through time are the somewhat subjective solutions to these problems; tightly defined compositional and temporal groups are better, longer-range solutions.

The main source of higher coefficients of variation in Lino groups (especially jars) is that each group has a few diameters that are substantially larger than most of the sample. The shapes of the Lino distribution curves appear to be among the most consistent of any of the grayware groups, as can be seen by comparing the small number of peaks and relative heights (i.e., points $\geq$ 15 percent) of the Lino groups (Table 2.73B) and those for the corrugated diameters (Table 2.72). These consistencies, in combination with the fact that wide neckbanded is as low in variability as later ceramics, make it quite possible to argue for some similarity in production throughout the sequence, although again, it seems likely that the later reductions in variability do represent some consolidation of production groups and vessel sizes. As suggested by the CV results, both neck-corrugated and Pueblo III Corrugated display somewhat more peaks than most other groups, but they are also the smallest samples.

Pueblo II Corrugated distributions are, on the whole, more erratic than those for Pueblo II-III Corrugated. The trachyte-sandstone mix group echoes the larger trachyte group modes in all variables except rim fillet width, in which there are otherwise no modal differentiations among temper groups apparent. Modes in sandstone and trachyte are quite similar in flare and orifice-to-rim distance. In Pueblo II-III Corrugated, the curves for sandstone and trachyte are quite similar in shape for all variables except diameter. The diameter distribution does suggest two smaller modes for sandstone (15 cm to 17 cm and 19 cm to 21 cm) and two larger ones (21 cm to 23 cm and 25 cm to 27 cm) for trachyte. The same two modes are also present in both Pueblo II trachyte and trachyte-sandstone mix, which adds some credence to the proposition that size/production groups may be represented here, although only in trachyte. There are possibly meaningful modes in Pueblo II-III rim flare to back up the diameter modes; however, both of the sandstone modes occur at intervals where there are also trachyte peaks (of which there are three) so that the variation may stem from measurement or some other extraneous source, although not necessarily. If pushed hard enough, then, the distributions can be found to suggest production groups, but the evidence is far from clear.

Multivariate Analyses. Multivariate analysis has an immense appeal because of its ability to produce a single result from a number of variables and the complex interactions among them. In view of the haziness of patterning apparent in the univariate statistics just discussed, consideration of variables in combination is a logical step. Multivariate analyses have the further ad-vantage that they compensate for the increased likelihood of incorrectly rejecting the null hypothesis (Type I error) that doing many univariate tests engenders (Harris 1975:5-6, 93). The trade-off for this apparent tidiness is that procedures are very complex and that it is necessary to make assumptions that may not be fully supported by the type of data usually at an archeologist's command.

Pitfalls and shortcomings notwithstanding, these techniques are tools that have potential value here and warrant their experimental use. Two complementary techniques have been applied: discriminant analysis and multivariate analysis of variance (MANOVA —both from the SAS package, SAS Institute 1982). Discriminant analysis has been used for its ability to place cases into groups based on metric variables; MANOVA gives a more detailed idea of the degree to which "independent" qualitative groups, such as temper group or site provenience, may be predicted by ceramic measurements individually, as well as in combination. The results of these analyses are presented in greater detail by Toll (1985).

Discriminant Analysis Experiment. Having noted that some patterns are present across single variables, use of a multivariate technique to test for higher level interactions is warranted. Discriminant analysis is theoretically well-suited because its purpose is to classify cases into groups. Its success at so doing is some measure of the reliability of these variables (Nie et al. 1975:445), and it has the potential of helping to gauge the distinctiveness of products from different areas and the likelihood of specialized producers.

There are a number of options available in the application of discriminant analysis. The results discussed here are based on runs that conform to the following specifications:

1) No groups were included that had so few numbers that an incomplete covariance matrix was necessary in generating discriminant functions.

2) The prior probability of classification in a group was established as proportional to sample size rather than equal among groups. This is preferable where the sample sizes are quite different, as is frequently the case here.

3) The program was allowed to test covariance matrices for similarity and to use functions based on pooled matrices when the covariances were statistically similar or separate matrices when different.

4) The classifications obtained for various types are somewhat different according to the number of variables used. When the discussion compares single types, the best classification percent is used (i.e., three variables for Pueblo II Corrugated).

5) Both the discriminant and MANOVA programs use only cases for which values for all the dependent (rim measurement) variables are present.

Test runs on the same data set using different parameters, such as equal prior probability, give different results although the patterns are usually similar. The above specifications were used because they seem to be the most conservative, which is desirable here because of the already large number of caveats.

Temper Classifications. It is clear that sample size does have an effect on the generation of the discriminant functions here (Table 2.74). Thus, in the early types where sandstone is the predominant temper, most or all cases have been placed in the sandstone group, which means a high success rate for sandstone cases and mostly failures in the other tempers. That sample size is not the sole determinant may be seen in the classification of items in the trachyte groups which are smaller than the sandstone groups in all but the Pueblo II-III two-variable classification line. In only one analysis—trachyte-tempered Pueblo III Corrugated by site—was the placement of items strictly proportional to the original sample.

The effects of using different combinations of variables are about as would be expected from the variable-by-variable discussion above. The addition

Table 2.74. Best discriminant analysis classifications of corrugated wares by temper, showing misclassifications and percentages correct.[a]

	Temper				
Type	Sandstone	Chalcedonic Sandstone	Trachyte	Trachyte+ Sandstone	Total
Wide Neckbanded no.	102	30	12	-	144
% of sample	70.8	20.8	8.3	-	
% of total placed in	100.0	0	0	-	
% of temper correct	100.0	0	0	-	70.8
% of misclassed items (n=42)	100.0	0	0	-	29.2
Narrow Neckbanded no.	177	43	54	6	280*
% of sample	63.2	15.4	19.8	2.1	
% of total placed in	100.0	0	0	0	
% of temper correct	100.0	0	0	0	63.2
% of misclassed items (n=102)	100.0	0	0	0	37.4
Neck Corrugated no.	65	13	32	-	110
% of sample	59.1	11.8	29.1	-	
% of total placed in	98.2	0	1.8	-	
% of temper correct	100.0	0	6.3	-	60.9
% of misclassed items (n=44)	100.0	0	0	-	39.1
PII Corrugated no.	224	28	202	16	470
% of sample	47.7	6.0	43.0	3.4	
% of total placed in	47.9	0	52.1	0	
% of temper correct	63.8	0	67.3	0	59.4
% of misclassed items	42.9	0	57.1	0	40.6
Misclassed in-% (n=191)	Tr-36	Tr-54	SS-33	Tr-81	
		SS-46		SS-19	
PII-III Corrugated no.	66	-	62	5	133
% of sample	49.6	-	46.6	3.8	
% of total placed in	49.6	-	46.7	3.8	
% of temper correct	57.6	-	75.8	100.0	67.7
% of misclassed items (n=43)	34.9	-	65.1	0	32.3
Misclassed in-%	Tr-42	-	SS-24	-	
PIII Corrugated no.	41	-	21	5	67
% of sample	61.2	-	31.3	7.5	
% of total placed in	80.6	-	17.9	1.5	
% of temper correct	90.2	-	33.3	0	65.7
% of misclassed items (n=23)	73.9	-	21.7	4.3	34.3
Misclassed in-%	Tr-7	-	SS-67	SS-60	
	Tr+SS-2	-	-	Tr-40	

[a] Analyses are based on rim fillet width, orifice diameter, and rim flare; PII-III analysis also includes orifice-to-rim distance.

Key:

% of total placed in shows percent of type placed in a given temper group by discriminant analysis (47.9% [245] of all 470 PII sherds were placed in the sandstone group).

% of temper correct indicates the percent of a temper group that was placed in the temper group corresponding to its temper (143 [63.8%] of sandstone-tempered PII sherds were placed in the sandstone group by the analysis).

% of misclassed items (n of misclassed items) indicates percent of items placed in a group other than their true temper group (% of 182 misclassified PII items [45] were placed in the sandstone group). In the first three types all misclassified cases were placed in the sandstone group so this line is omitted.

Misclassed in-% shows the percentages of the temper misclassified in other temper groups (54% of the PII Chalcedonic Sandstone was placed in the trachyte group and 46% in the sandstone group).

of rim flare to fillet and diameter in wide neckbanded, narrow neckbanded, neck-corrugated, and Pueblo II Corrugated makes only a slight improvement in the overall classification success, but makes a more noticeable difference in Pueblo II-III and Pueblo III Corrugated. The subsequent application of MANOVA to the same data revealed that the addition of flare to diameter and fillet would be likely to show more difference in a discrimination of items by site rather than temper (see below). All of the remaining discriminant analyses use three variables rather than two. Only in Pueblo II-III Corrugated does the orifice-to-rim distance (to create a "four variable" analysis) improve the classification rate. The inter-variable correlations in Pueblo II-III Corrugated are, on the whole, lower than in the Pueblo II and Pueblo III Corrugated types (Table 2.70). This must account, in part, for this variable's greater contribution to successful classification in the Pueblo II-III group.

Of most relevance to ceramic production is how items are placed in temper groups, based on the compressed measures generated. The placement of all neck-decorated items in the generalized sandstone group suggests that by these measurements all production areas were making vessels that conformed to general size and style characteristics (Table 2.74). The ceramic and geological expectation is that the sandstone-tempered group will be the most dispersed group. The discriminant analysis finds that each temper group is sufficiently similar to the sandstone group that all cases could be attributed to that most dispersed group. There is some suggestion that this situation may have begun to change during the production of neck-corrugated, as a few items have been correctly classified as trachyte-tempered.

Pueblo II Corrugated is more evenly divided between sandstone and trachyte tempers. There is a dramatic shift in the number of trachyte-tempered items correctly classified, but there is also a concomitant reduction in the correctly placed sandstone-tempered items. Two aspects of this change seem important: 1) there is sufficient difference that up to 82 percent of the trachyte-tempered items are correctly placed; and 2) conversely, a substantial overlap remains and that numbers of both sandstone and trachyte cases are still incorrectly placed.

The composition of the incorrectly placed groups gives some idea as to between-group similarities in these rim attributes. While the chalcedonic sandstone items had been placed in the sandstone category with everything else in the types prior to Pueblo II Corrugated, a majority is placed in trachyte Pueblo II Corrugated (54 percent of 28); 36 percent of sandstone is placed in trachyte, and 81 percent of trachyte plus sandstone cases are in the trachyte class. While many of the simple statistics suggest great similarity of trachyte+sandstone with trachyte (as does the discriminant placement within Pueblo II Corrugated), in Pueblo II-III Corrugated the trachyte+sandstone forms the only category in which all members are included and no other items are classified. In Pueblo III Corrugated, trachyte+sandstone items are split between sandstone and trachyte; this time with three of five placed in sandstone.

The cross-temper changes in classification through serial types intimates that what metric differences there are among temper groups may not always be the same through time. Whether this, in turn, means that the variation seen is random or that areal expression of differences were different through time, is unknown. That this is not a simple picture testifies most importantly that while the variables do have some discriminating power, there is substantial overlap in nearly all categories, suggesting that types of production were basically similar around the supply area.

Classification by Site. Differences in ceramics among sites may be attributed to three main causes:

1) Temporal differences. Once again, there is an attempt to control this on stylistic/typological grounds, but as the types involved may last up to 150 years, there is much room for intra-type temporal variability.

2) Functional differences. If different sites had different emphasis on various activities involving ceramics, then between-site differences in rim measurements might well be expected.

3) Ceramic acquisition differences. If different sites had different sources of ceramics, then some differences should be reflected in these measurements.

Site differences have thus been tested on two levels. All of the measured items in each type have been entered in discriminant analyses and the type-temper groups have been entered. The analysis using as many items as possible (that is, with no exclusions based on subgroups; Table 2.75) is most likely to bear more on consistent functional differences among sites since the production aspect is presumably averaged across the assemblage.

The percent of correct classification by site is quite consistently in the neighborhood of 60 percent for the six types, although 73 percent of the Pueblo III Corrugated was correctly placed (see totals in Table 2.75). This rate is generally achieved by the correct placement of 69 percent to 95 percent of the cases from the site, with the largest sample and a lower correct placement rate for the other sites. Particularly in earlier types, where 29SJ 627 has by far the largest sample, it also has the most cases classified (as predetermined by the use of proportional prior probability), the highest correct classification percent, and the most misclassified cases. The most common pattern is for percentage rank to be fairly consistent across these aspects of the classification. Because the site with the largest sample tends to receive disproportionately more items in the generated classification relative to the actual sample, the other sites often receive fewer classifications than the sample expectation. Sample size is again clearly important, but it does not completely dictate the classification results.

Probably the most interesting violation of the above patterns is that more Pueblo II Corrugated cases are classified as from Pueblo Alto than from 29SJ 627, though 29SJ 627 has the largest sample. This could be taken to suggest that a broader variety of rim measurements were recovered from Pueblo Alto, perhaps indicating either a broader supply area for that site or a wider range of functions. Pueblo Alto continues to have the largest number of placements in the Pueblo II-PIII and Pueblo III Corrugated groups, but in these types the suggestion is less clear because Pueblo Alto also has the largest samples of each type. The differences in site sample sizes in the Pueblo II-III and Pueblo III groups are less than they are earlier, however, which gives Pueblo Alto's continued classificatory preference more weight.

Another example of sample size not controlling classification is that site 29SJ 1360 and 29SJ 629 have identical samples of neck-corrugated, yet 29SJ 629 received 30 percent of the misclassifications and 29SJ 1360 received only 2 percent. 29SJ 629's correct classifications also form a much higher percentage (63 percent) than do 29SJ 1360's (14 percent). This result seems to be confined to neck-corrugated; 29SJ 629 does not stand out elsewhere. Granting that sample size is important, it must still be noted that the functions generated from the 29SJ 627 data are consistently inclusive of the majority of cases from all the other sites in the pre-Pueblo II Corrugated types. If conceptualized as circles or sets, there is a great overlap between sites in each type. The most important lesson from this classification experiment is that insofar as these rim measurements represent production or especially function, the graywares suggest considerable congruence among sites through time.

Classification of Specific Temper Groups by Site. In an effort to more clearly isolate production's influence on the site comparisons, discriminant analyses were also performed to test classification of individual temper categories into site groups (Table 2.76). Although relationships are really more complex than the data can discriminate, this procedure stands to probe two related aspects of ceramic production and function.

First, the classification results from complete site-type groups are just successful enough to leave the question of functional differences a murky one. Examining only nonlocal tempers (chalcedonic sandstone and trachyte), successful sorting by site can be taken to suggest that there are functional and/or temporal differences among sites. It could also mean that different sites acquired pottery from different potters in the production areas represented by these tempers. Further, it could also relate, in part, to classificatory changes. For example, the operative definition of Pueblo II-III Corrugated does seem to have been somewhat different at 29SJ 627 and Pueblo Alto (Toll and McKenna 1987:94-95).

Table 2.75. Discriminant analysis of whole grayware types by site, using the number of variables giving the best classification results for each type.[a]

	Sites						
Type-Temper	29SJ 299	29SJ 629	29SJ 1360	29SJ 627	29SJ 389	29SJ 633	Total
Wide Neckbanded no.	-	18	37	85	7	-	147
% of sample	-	12.2	25.2	57.8	4.8	-	
% of total placed in	-	0	10.9	87.1	2.0	-	
% correctly placed	-	0	10.8	91.8	14.3	-	56.5
% of misclassed items (n=64)	-	0	18.8	78.1	3.1	-	43.5
Misclassed in-%	-	627-83 1360-17	627-84 389-5	1360-8	627-57 1360-29	-	3/4
Narrow Neckbanded no.	1	28	56	174	38	-	297
% of sample	0.3	9.5	18.9	58.8	12.8	-	
% of total placed in	0	1.7	5.7	89.9	2.7	-	
% correctly placed	0	14.3	8.9	92.5	7.9	-	58.2
% of misclassed items (n=124)	0[b]	0.8	9.7	85.5	4.0	-	41.8
Misclassed in-%	627[b]	627-71 1360-14	627-89 629-2	1360-5 389-3	627-92	-	4/4
Neck Corrugated no.	5	22	22	62	9	-	120
% of sample	4.2	18.3	18.3	51.7	7.5	-	
% of total placed in	0	36.4	13.6	50.0	0	-	
% correctly placed	0	63.4	13.6	91.9	0	-	61.7
% of misclassed items (n=46)	0	30.4	2.2	67.4	0	-	38.3
Misclassed in-%	627-100	627-37	627-50 629-36	629-6 1360-2	627-78 629-22	-	3/5
PII Corrugated no.	-	14	26	297	257	7	601
% of sample	-	2.3	4.3	49.4	42.8	1.2	
% of total placed in	-	0.3	2.0	47.8	49.9	-	
% correctly placed	-	7.1	7.7	69.0	65.8	-	62.7
% of misclassed items (n=224)	-	0.4	4.5	36.6	58.5	-	37.3
Misclassed in -%	-	389-79 1360-14	389-85 627-4 629-4	389-31 1360-.3	627-32 1360-3	389	4/5
PII-III Corrugated no.	-	5	-	70	75	-	150
% of sample	-	3.3	-	46.7	50.0	-	
% of total placed in	-	3.3	-	33.3	63.3	-	
% correctly placed	-	80.0	-	48.6	77.3	-	64.0
% of misclassed items (n=54)	-	1.9	-	29.6	68.5	-	36.0
Misclassed in -%	-	389-20	-	389-51	627-21 629-1	-	3/3
PIII Corrugated no.	-	-	-	32	42	5	79
% of sample	-	-	-	40.5	53.2	6.3	
% of total placed	-	-	-	25.3	73.4	1.3	
% correctly placed	-	-	-	53.1	95.2	20.0	73.4
% of misclassed items (n=21)	-	-	-	14.3	85.7	0	26.6
Misclassed in -%	-	-	-	389-47	627-5	389-60 627-20	2/3

[a] Three variables except for PII-III with four.

[b] Placed without being entered in the discriminant function.

For Key to row headings, see Table 2.74.

Misclassed rows give sites into which items have been incorrectly placed. The number following is the % of a site's total complement placed in the incorrect site group.

In the total column the number of sites with misplaced items is shown: 3/4 indicates 3 of 4 sites contain misplaced items.

Table 2.76. Discriminant analysis classification of corrugated type-temper groups by site.[a]

		Sites					
Type-Temper	Variables/ Pooled	29SJ 629	29SJ 1360	29SJ 627	29SJ 389	29SJ 633	Total
Wide Neckbanded							
sandstone	3/N	14	21	59	6	-	100
% correctly placed		14.3	23.8	91.5	16.7	-	62.0
Chalcedonic sandstone	3/Y	-	13	17	-	-	30
% correctly placed		-	53.9	82.4	-	-	70.0
Narrow Neckbanded							
sandstone	3/Y	16	37	105	13	-	171
% correctly placed		25.0	27.0	89.5	7.7	-	63.7
Chalcedonic sandstone	3/Y	7	8	24	-	-	39
% correctly placed		14.3	25.0	95.8	-	-	66.7
Trachyte	3/Y	3	8	39	4	-	54
% correctly placed		33.3[b]	25.0	97.4	0	-	75.9
Neck Corrugated							
sandstone	3/Y	9	14	36	-	-	59
% correctly placed		0	57.1	91.7	-	-	69.5
Trachyte	3/Y	3	4	19	-	-	26
% correctly placed		33.3[c]	75.0	100.0	-	-	88.5
PII Corrugated							
sandstone	3/N	-	10	163	47	-	220
% correctly placed		-	80.0	98.8	8.5	-	78.6
Chalcedonic sandstone	3/Y	-	-	13	11	-	24
% correctly placed		-	-	92.3	90.9	-	91.7
Trachyte	3/Y	9	13	103	71	5	201
% correctly placed		22.2	46.2	78.6	59.2	60.0	66.7
Trachyte + sandstone	3/Y	-	-	6	9	-	15
% correctly placed		-	-	66.7	88.9	-	80.0
PII-III Corrugated							
sandstone	4/N	-	-	42	23	-	65
% correctly placed		-	-	85.7	65.2	-	78.5
Trachyte	4/Y	-	-	22	34	-	56
% correctly placed		-	-	36.4	82.4	-	64.3
PIII Corrugated							
sandstone	3/N	-	-	20	16	4	40
% correctly placed		-	-	70.0	50.0	50.0	60.0
Trachyte	3/Y[d]	-	-	9	11	-	20
% correctly placed		-	-	88.9	90.9	-	90.0

3 variables—fillet, diameter and rim flare.

4 variables—fillet, diameter, flare and orifice-to-rim distance.

[a] Sample numbers by temper and percent correctly classified are shown from analyses using different numbers of metric rim variables. The analyses include only the sites shown and only type-temper groups with sufficient numbers for complete matrices.

[b] Covariance matrix of less than full rank--one variable deleted; view result accordingly.

[c] An analysis omitting 29SJ 629 (incomplete matrix) makes the same 29SJ 627 and 29SJ 1360 placements and raises the overall % correctly classified to 95.7%.

[d] 3 and 4 variable analyses give the same result.

Second, in the undifferentiated sandstone group, some part of which is conceivably of local production, a high classification rate could signify production at a particular site. Production, however, would be difficult to separate from the functional or temporal possibilities that exist for the extra-canyon tempers. Thus, comparison of classification rates between these tempers and sandstone is a necessary partial check.

The subdivided analyses have two noteworthy results: 1) the correct classification percentages are on the whole higher; and 2) the nonlocal temper groups are often more successfully classified than the possibly local sandstone groups. Sample sizes are again a factor since subdivision by temper and site creates smaller groups and fewer sites with sufficient sherd samples for the analysis. With fewer site categories, the likelihood of "randomly" correctly classified cases increases. Still, the classification rate is better than for whole types even where there are four or five sites. This suggests, then, that there were some differences among sites in their relationship to producers, especially since the temper groups assumed to be nonlocal are better discriminated by site than the undifferentiated sandstone-tempered groups. The result supports the idea that individual producers made recognizable and slightly different products.

Deviations from group membership expected, based on sample distribution, are the most interesting. They occur in these analyses more in the ways in which cases are misclassified than in those correctly placed (Tables 2.76 and 2.77). There is a temptation to interpret cases placed at a particular site as products of that site. That is, since the discriminant function is based on a profile of the vessels from a given site, when vessels from another site show an affinity to that profile, some relationship, possibly one of supply, is suggested. This assumption is fraught with difficulties as can be quickly seen in the fact that such low levels of correct placement of a site's sherds in its own category are possible. Additionally, it is clear that point of origin is not implied by a site's ceramic profile (although it is a common archeological assumption that the location where a particular product is the most abundant is likely to be the source of the product). That said, it is notable that 29SJ 629 and Pueblo Alto have consistently low percentages of sandstone-tempered sherds attributed to them while 29SJ 1360 and 29SJ 627 have more (Table 2.77A). The two most noteworthy examples of this are that 44 percent of the neck-corrugated sandstone-tempered misclassifications were placed in 29SJ 1360, which comprises only 24 percent of the total sample; further, only 2 percent of all sandstone-tempered Pueblo II Corrugated placements were in the Pueblo Alto group, although it comprises 21 percent of the sample. Although the proposal concerns whiteware rather than grayware, it has been argued that 29SJ 1360 is more likely to have been a ceramic production site than the others in this analysis (McKenna and Toll 1984:203-206). This small classificatory preference for 29SJ 1360 bolsters that proposal; if valid, it suggests that Pueblo Alto and 29SJ 629 were not producers.

The inordinately small number of sandstone-tempered Pueblo II Corrugated assignments to Pueblo Alto in Pueblo II Corrugated is a peculiar anomaly. It is anomalous as compared with Pueblo II-III Corrugated, in which Pueblo Alto is only slightly below proportional expectation. It is also economically anomalous: if Pueblo Alto were in some way involved in the distribution of vessels, or conversely, in the consumption of local vessels, a stronger affinity with other sites would be expected. Perhaps the fact that nearly all Pueblo Alto sandstone-tempered Pueblo II Corrugated vessels were placed in the 29SJ 627 groups shows that affinity. The greater temporal similarity between Pueblo Alto and 29SJ 627 than between Pueblo Alto and 29SJ 1360 and 29SJ 629 also influences this result.

It is tantalizing that 29SJ 627, a "small site," shows this classificatory affinity for sandstone-tempered vessels, but the Pueblo II sandstone sample is not well balanced when divided by site, and sample size artifacts are unquestionably part of the classification. The trachyte sample, however, is more evenly distributed among sites, yet in both Pueblo II and Pueblo II-III Corrugated, more cases are placed in the Pueblo Alto group than the proportional expectation based on sample size (even though in Pueblo II Corrugated the 29SJ 627 sherds constitute 51.2 percent of the total). Pueblo II placements in 29SJ 627 are not far off proportion, but substantially more cases from other sites are classed in the Pueblo Alto group. This recurs in Pueblo II-III Corrugated,

Table 2.77. *Discriminant analysis summary showing incorrect and correct placements of sandstone and trachyte cases by site.*

	Sites				
Type (total n)	29SJ 629	29SJ 1360	29SJ 627	29SJ 389	29SJ 633
A. Sandstone-tempered cases					
Wide Neckbanded (100)					
% correctly placed	3.2	8.1	87.1	1.6	-
% of incorrectly placed	5.3	13.2	78.9	2.6	-
% of placements	4.0	10.0	84.0	2.0	-
% of sample	14.0	21.0	59.0	6.0	-
Narrow Neckbanded (171)					
% correctly placed	3.7	9.2	86.2	0.9	-
% of incorrectly placed	4.8	19.4	75.8	-	-
% of placements	4.1	12.9	82.5	0.6	-
% of sample	9.4	21.6	61.4	7.6	-
Neck Corrugated (59)					
% correctly placed	-	20.0	80.0	-	-
% of incorrectly placed	-	44.4	55.6	-	-
% of placements	-	27.6	72.4	-	-
% of sample	15.5	24.1	60.3	-	-
PII Corrugated (220)					
% correctly placed	-	4.6	93.1	2.3	-
% of incorrectly placed	-	6.4	93.6	-	-
% of placements	-	5.0	93.2	1.8	-
% of sample	-	4.5	74.1	21.4	-
PII-III Corrugated (65)[a]					
% correctly placed	-	-	70.6	29.4	-
% of incorrectly placed	-	-	57.1	42.9	-
% of placements	-	-	67.7	32.3	-
% of sample	-	-	64.6	35.4	-
PIII Corrugated (40)					
% correctly placed	-	-	58.3	33.3	8.3
% of incorrectly placed	-	-	56.3	31.3	12.5
% of placements	-	-	57.5	32.5	10.0
% of sample	-	-	50.0	40.0	10.0
B. Trachyte-tempered cases					
Narrow Neckbanded (54)					
% correctly placed	2.4	4.9	92.7	-	-
% of incorrectly placed	-	7.7	92.3	-	-
% of placements	1.9	5.6	92.6	-	-
% of sample	5.6	14.8	72.2	7.4	-
Neck Corrugated (26)					
% correctly placed	4.3	13.0	82.6	-	-
% of incorrectly placed	-	-	100.0	-	-
% of placements	3.8	11.5	84.6	-	-
% of sample	11.5	15.4	73.1	-	-
PII Corrugated (201)					
% correctly placed	1.5	4.5	60.4	31.3	2.2
% of incorrectly placed	6.0	9.0	34.3	50.7	3.0
% of placements	2.0	6.0	51.7	37.8	2.5
% of sample	4.5	6.5	51.2	35.3	2.5

Table 2.77. (continued)

	Sites				
Type (total n)	29SJ 629	29SJ 1360	29SJ 627	29SJ 389	29SJ 633
PII-III Corrugated (56)*					
% correctly placed	-	-	22.0	77.8	-
% of incorrectly placed	-	-	30.0	70.0	-
% of placements	-	-	25.0	75.0	-
% of sample	-	-	39.3	60.7	-
PIII Corrugated (20)					
% correctly placed	-	-	44.4	55.6	-
% of incorrectly placed	-	-	(1 of 2)	(1 of 2)	-
% of placements	-	-	45.0	55.0	-
% of sample	-	-	45.0	55.0	-

% correctly placed is the n of correctly placed items from a site divided by the total n of correctly placed items.
% of incorrectly placed taken from the number of sherds that were placed in sites from which they did not come.
% of placements is taken from the whole sample, since every case is classified by the analysis.
Except for PII-III Corrugated, the 3 variable (diameter, fillet, flare) analysis results are shown.
* 4 variable analysis.

although in that type, cases from Pueblo Alto dominate the sample. The low placements of trachyte and the greater placements of sandstone in 29SJ 627 and the converse at Pueblo Alto reiterate not only the Pueblo Alto-Chuska connection, but also the greater occurrence of sandstones at the other sites (the sandstone and trachyte placements here are from separate analyses and are independent). This was already known from simple distributions, but this classification adds somewhat to the distributional picture by suggesting further site affinities. That Pueblo III trachyte is placed precisely proportionally to the sample, and Pueblo III sandstone is very nearly proportional, suggests little difference among sites, perhaps in correspondence with the proposed altered conditions during at least part of its production (Toll 1985; Toll et al. 1980).

Multivariate Analysis of Variance. Although subject to no fewer cautions and ambiguities, this technique gives more of an idea as to which variables contribute to differences among groups. Table 2.78 summarizes the elements of a number of analyses which have probability levels of less than .10. In addition to the discriminant analyses, these runs test for the effects of temper and of site on the compressed variables generated from the rim measurements. The meaning of the values in Table 2.78 may be summarized as follows (but reference to fuller explanation is encouraged: Harris 1975; Nie et al. 1975; SAS Institute 1982). The F distribution is used to test both "univariate" and multivariate analyses of variance results (R. Harris [1975:7] points out that ANOVA could be considered multivariate). As Harris stresses, multivariate techniques are outgrowths from simpler techniques and an understanding of the basic technique aids in comprehending the more complex one. For univariate tests, F is the ratio between the variance of the among-group sample and the within-group sample (e.g., Kushner and DeMaio 1980). These are estimated by summing the squares of the differences between each case and the whole sample's mean (among group sum of squares), by summing the differences between each case and its group's mean (within-group), and by dividing each sum of squares by its degrees of freedom (among-group df is the number of categories minus one, within-group df is sample size minus the number of categories). Therefore, *if* the variability in the whole sample is greater than that in the subgroups, F will have a value larger than one. The distribution of F with associated degrees of freedom is known, and the likelihood of a chance occurrence of a difference like

Table 2.78. Summary of tests of MANOVA values significant at .05 and .10.

Type Variables Used	Variable F-p	Site F	Temper F	Site and Temper F	Wilks' for Site	Wilks' for Temper
Narrow Neckbanded-2	Diameter-.05	-	Diameter-.05	-	-	.05
	Fillet-.05	-	-	Diameter-.10	-	-
Wide Neckbanded-3	-	-	-	Diameter-.10	-	-
Narrow Neckbanded-3	Diameter-.05	Diameter-.05	Flare-.10	-	.05	-
	Flare-.05	Flare-.05	-	-	-	-
Neck Corrugated-3	Flare-.05	Flare-.05	-	Diameter-.10	.05	-
PII Corrugated-3	Fillet-.05	Fillet-.05	Flare-.10	-	.05	-
	Flare-.05	Flare-.05	-	-	-	-
PII-III Corrugated-3	Flare-.05	Flare-.05	-	-	.05	-
PIII Corrugated-3	Diameter-.05	Diameter-.05	Diameter-.05	Diameter-.05	.05	.05
	Flare-.05	Fillet-.05	Flare-.10	-	-	-
	-	Flare-.05	-	-	-	-
PII Corrugated-4	Fillet-.05	Fillet-.05	-	-	.05	-
	Flare-.05	Flare-.05	-	-	-	-
	O-R dist-.05	O-R dist-.05	-	-	-	-
PII-III Corrugated-4	Flare-.05	-	-	Flare-.05	.05	-
	O-R dist-.05	-	-	-	-	-
PIII-4 identical to 3						
Trimmed data sets:						
PII-III Corrugated-3	Fillet-.05	Fillet-.05	Fillet-.05	Flare-.05	.05	.05
	Flare-.05	Flare-.05	Flare-.05	Diameter-.10	-	-
			Diameter-.10			
PII-III Corrugated-3	Flare-.05	-	Diameter-.05	-	-	.05
			Flare-.05	-	-	-
PIII Corrugated-3	Diameter-.05	Diameter-.05	Diameter-.05	Diameter-.05	.05	.05
	Flare-.10	Flare-.05	-	-	-	-

Variables: 2=diameter, fillet; 3=diameter, fillet, flare; 4=diameter, fillet, flare, orifice-to-rim.

that found in the analysis can be assessed. Thus, a significant F indicates that the variability in dependent variables (pot measurements) of the subgroups defined by an independent variable (such as temper or site) is meaningfully different from the variability of the whole group. Calculation of multivariate F's is more complex, but the concept is similar in that they compare the variance accounted for by "the model," or complex of independent variables, with the variance that can be attributed to error. Thus, when an F value under these circumstances is large enough to be significant, it may be said that the variables in the model generate non-random variability in the dependent variables (rim measurements) and are worthy of further interpretation.

The statistics appearing in Table 2.78 represent the following (extracted from SAS Institute 1982: 180):

"Variable F": The F ratio (between mean square for the model and mean square for the error), which tests for how well the model accounts for the behavior of an individual variable.

"R^2": Another ratio, between the model sum of squares and the corrected total sum of squares for a given dependent variable, the potential values are 0 to 1. Whereas the F ratio tests the significance of how the model accounts for the variable, R^2 gives an index of how much of the variation in the variable may be accounted for by the model.

"Type III Site F, Temper F, and Combined F": To eliminate the effects of order of inclusion, Type III sum of squares is a machine method of calculation of sum of squares that adds the variable in question last. That is, the Type III sum of squares for each independent variable is equivalent to that for the others, which is not possible with Type I sum of squares. Thus, it is possible to see the significance of the variability accounted for in the rim measurement in question by site, temper and a combination of the two.

"Wilk's lambda": This statistic is also compared with the F distribution to determine significance. In essence, the statistic summarizes the way in which each of the independent variables accounts for variation in all of the dependent variables.

Although the MANOVA runs are based only on the four major temper groups, the MANOVA data sets include very small temper or site groups which were trimmed from the discriminant analyses. Removing small type-site-temper groups from the analysis does have an effect on the results, primarily making temper more nearly equivalent to site in explaining variability (Table 2.78).

Of all the types, the fewest significant differences on any of the variables were found in wide neckbanded. Only for the site-temper combined effects was a significant value found, and that only a suggestive one at $p<.10$. In narrow neckbanded, the introduction of the rim flare variable has some rather surprising effects. Without the flare variable, temper is explained at the .05 level by rim diameter and the F value for rim fillet width is significant, with temper having a significant effect on the overall outcome. With the addition of the flare information, temper no longer has a significant effect, but site does; both diameter and flare show significant differences in explaining the model as a whole. The results for neck-corrugated follow a similar pattern to narrow neckbanded, with the exception that flare is the primary variable in accounting for differences. That flare should have the effect that it does in these two early types is somewhat odd because it is not conventionally thought to be an important aspect of these types. The univariate analyses show that flare is extremely variable compared to rim fillet and rim diameter in these types, and this variability probably contributes to the between-group differences being expressed in the significant F values. Rim flare continues to generate significant results in the later types, and there is a possibility that rim flare may have some significance (most likely a temporal one) in earlier types as well as later ones. The significant F values for flare in narrow neckbanded and neck-corrugated occur in explanation of site rather than temper variability. The site association accords with the discriminant analysis and with the suggestion that flare may have temporal meaning earlier than supposed.

The largest group, Pueblo II Corrugated, shows site of recovery to have a significant effect on rim morphology. Rim diameter does not seem to be an important variable in this type group and temper only generates one significant F value (.10). Again, rim flare consistently shows more differences than do the other variables. Flare's importance is echoed in Pueblo II-III Corrugated where it is the only variable with significant values except for one occurrence of orifice-to-rim distance. This type, as well, shows a significant effect of site (not to say site effects). As indicated, some analytical drift appears to have occurred between sites, such that rim eversion was somewhat differently applied as a criterion for type assignments. This, unfortunately, beclouds the ceramic significance of this statistical result, but the possibility must be entertained that there is also a ceramic significance, particularly since the flare variable is also important in types in which it is not a criterion for type assignment. Because degree of rim eversion—at least in Pueblo II, Pueblo II-III and Pueblo III Corrugated—does seem to correlate with time, there is a real possibility that this result is affirming suspicions of different temporal emphases at these sites.

The Pueblo III Corrugated analyses involve more variables and show significant temper effects. As suggested by the discriminant analysis, the inclusion of orifice-to-rim distance has very little effect on the outcome, although the F value for Wilks' lambda is somewhat higher with its inclusion. Rim fillet width (the variable that seems most likely to be purely stylistic) generates significant values least often of any of the variables, but it does figure in Pueblo III Corrugated. Rim diameter is also more prominent than in other types. It is intriguing that differences are more apparent in this latest type.

Because the excavated portion of site 29SJ 633 is almost surely later than the other two sites with this type present (Pueblo Alto, 29SJ 627), time may well be an important factor. That temper has a significant multivariate effect (only true of narrow neckbanded in the other untrimmed analyses; Table 2.78) is tantalizing here because of the proposition made elsewhere that by the approximate period of production of Pueblo II-III Corrugated, there was some decline in the organization of the system in Chaco Canyon. Could cross-production group similarities have declined as a result? The differences in diameter may also tie to time because there does seem to be a trend to small grayware jars later in Chaco Canyon (Figure 2.5).

As expected, small temper-site groups do have an effect on the MANOVA results. The effect is most evident in the Pueblo II Corrugated analysis in which temper is shown as having an overall effect expressed especially in fillet and flare measurement. The overall effect of site remains, suggesting that small temper groups were causing some lack of clarity. The trimmed analysis for Pueblo II-III and Pueblo III Corrugated are largely the same as the others (relatively few cases were removed), except that the relative influence of diameter seems to be greater in both types.

In summary, the MANOVA results echo the discriminant analyses in that cases are more easily related to the site at which they were found than the temper which they contain (Table 2.78). Taking into account the number of analyses in which the individual variables were used, the order in which the rim measurements used here contribute to differentiating groups is as follows: rim flare most, rim diameter, orifice-to-rim distance, and rim fillet width least. This ordering is reflected in the R^2 values for individual variables (Toll 1985). The majority of these are low (often less than .10). The largest value is .442, found, again surprisingly, for rim flare in neck-corrugated. Flare also has R^2 values of greater than .20 (an arbitrary cut-off) in the Pueblo II and untrimmed Pueblo III Corrugated analyses. Rim diameter has high values only in the Pueblo III analyses. The occurrence of many low and no very high R^2 values may be regarded as corollary to the somewhat sporadic results of these analyses. At any rate, these variables do not serve to powerfully distinguish site and temper groups. That the combined site-temper effects are significant less often than those two variables individually suggests that the supply to these sites was similar. The clearest exception is Pueblo III Corrugated, which comes from three quite different site contexts. This suggested generality of supply is somewhat at odds with the partially successful site classification of temper groups by the discriminant analyses. The combined impression, then, is one in which there is a great deal of similarity across temper and site groups, but that within that similarity groups are identifiable, although the boundaries between the groups are likely to be very indistinct.

Grayware Surface Manipulation. Multivariate techniques have been used to explore whether or not products of general areas or ceramics found at different sites can be identified through measured variables. Some of these attributes (or consistency in them) could serve to visually identify an areal product, especially fillet width or rim flare, but combinations of cues must have contributed to such identification. The finding that metric discrimination is possible but that the results show substantial overlap among groups, raises the question of other visual attributes contributing to identifications.

Modern cases make it seem likely that the products had characteristic shapes and decorations that would have identified at least community of origin. The Chaco Project analysis recorded a number of grayware "surface manipulations." These include coil width and treatment (such as narrow clapboard bands or 5 mm+ corrugated coils), type of corrugation, and treatments to the corrugated surface (such as incising or flattening). To investigate the possibility of visual distinctions within types, temper and site groups are cross-tabulated with major vessel construction and surface manipulation categories (Tables 2.79, 2.80, and 2.81).

The number of categories of construction recorded is not large (17, not including broad ones such as "undifferentiated corrugated") and the present analysis is simplistic in that it does not consider combinations of attributes states (e.g., 2 mm to 5 mm corrugated coils with appliqued scrolls), which would

Table 2.79. Primary surface manipulation of grayware types by major temper group.

	Temper				
Type	Sandstone	Chalcedonic Sandstone	Trachyte	Trachyte + Sandstone	Total
Wide Neckbanded					
Wide neckbanding	51	12	6	-	69
Wide clapboard	123	42	17	-	182
Total	174	54	23	-	251
Narrow Neckbanded					
Narrow neckbanding	31	7	24	2	64
Wide neckbanding	25	5	2	0	32
Narrow clapboard	129	25	50	5	209
Wide clapboard	99	29	20	1	149
Patterned corrugated	20	1	12	1	34
Total	304	67	108	9	488
Neck Corrugated					
Narrow clapboard	9	2	5	-	16
2-5 mm corrugated coils	12	2	7	1	22
5 + mm corrugated coils	42	14	8	1	65
Festoon corrugated	29	6	18	1	54
Patterned corrugated	22	-	11	-	33
Total	114	24	49	3	190
PII Corrugated					
Narrow clapboard	18	2	16	5	41
2-5 mm corrugated coils	251	24	210	18	503
5 + mm corrugated coils	59	9	23	1	92
Patterned corrugated	21	9	45	4	79
Total	349	44	294	28	715
PII-III Corrugated					
2-5 mm corrugated coils	54	4	60	9	127
5 + mm corrugated coils	10	-	6	-	16
Patterned corrugated	2	-	14	1	17
Total	66	4	80	10	160
PIII Corrugated					
2-5 mm corrugated coils	38	3	13	4	58
5 + mm corrugated coils	7	-	4	1	12
Total	45	3	17	5	70

be more precise identifiers. Only categories with sufficient numbers are included in the present analysis. If combined attributes had been included, frequencies would plummet, especially because the frequency of items with two recorded surface treatments is only 10 percent to 14 percent in all types except neck-corrugated (37 percent). Separation of producers would have been more feasible had types of surface patterning been recorded, but this too would generate many small groups (coil widths of patterned corrugated pieces were combined here and the category is still small).

In spite of its drawbacks, the surface treatment analysis does provide a more or less independent check on the metric analyses. Because of the nature of the data, the problems of incomplete comprehension of the multivariate ether will be exchanged for the more pedantic but familiar multiple comparison problem (Harris 1975).

Tests of temper groups yield significant results in the four contiguous types—narrow neckbanded, neck-corrugated, Pueblo II and Pueblo II-III Corrugated—but are lacking at both ends of the

Table 2.80. Site occurrence of primary grayware surface manipulation by type with minor and undifferentiated categories excluded.

	Sites					
Type	29SJ 629	29SJ 1360	29SJ 627	29SJ 389	29SJ 633	Total
Wide Neckbanded						
Wide banding	3	10	12	45	1	71
Wide clapboard	10	13	55	107	12	197
Total	13	23	67	152	13	268
Narrow Neckbanded						
Narrow banding	2	5	17	39	7	70
Wide banding	-	6	11	13	1	31
Narrow clapboard	3	18	31	117	60	229
Wide clapboard	11	13	43	86	5	158
Patterned corrugated	1	5	11	14	5	36
Total	17	47	113	269	78	524
Neck Corrugated						
Narrow clapboard	-	2	5	10	-	17
2-5 mm corrugated coils	-	4	6	14	1	25
5+ mm corrugated coils	2	26	13	24	4	69
Festoon corrugated	5	7	9	25	12	58
Patterned corrugated	-	3	5	23	4	35
Total	7	42	38	96	21	204
PII Corrugated						
Narrow clapboard	-	7	24	15	-	46
2-5 mm corrugated coils	14	23	329	266	6	638
5+ mm corrugated coils	4	5	71	25	3	108
Patterned corrugated	2	2	47	39	-	90
Total	20	37	471	345	9	882
PII-III Corrugated						
2-5 mm corrugated coils	4	-	59	74	7	144
5+ mm corrugated coils	-	-	10	7	-	17
Patterned corrugated	1	-	10	6	-	17
Total	5	-	79	87	7	178
PIII Corrugated						
2-5 mm corrugated coils	2	-	27	34	6	69
5+ mm corrugated coils	-	-	8	4	-	12
Total	2	-	35	38	6	81

An extremely attentive reader will note minor discrepancies in counts between the tables in McKenna and Toll (1984: 486-487) and those given here. The discrepancies for 29SJ 627 are due largely to the addition of a number of misplaced cases to the 29SJ 627 data set subsequent to the initial 29SJ 627 analysis (Toll and McKenna 1992) and the 29SJ 1360 write-up. Other discrepancies result from the use of only jars and only the "primary" surface manipulation in these tables.

sequence in wide neckbanded and Pueblo III Corrugated. The types with significant temper tests all contain larger numbers of well-represented surface manipulations than the types lacking significant differences. Wide neckbanded and Pueblo III Corrugated contain only two surface categories of any frequency. Narrow neckbanded and Pueblo II Corrugated are the two most abundant types, but both neck-corrugated and Pueblo II-III Corrugated are less abundant than wide neckbanded, so that sample size is not the sole explanation for surface diversity. The differences found are quite consistent from type to type. The trachyte-tempered items have wide coils less often than statistically expected and have some

Table 2.81 Chi-square test results from comparisons of type-temper and type-site groups by grayware surface manipulation.

Test Entries	No.	Controlling Group	Table Dimensions	χ^2	df	p	C	Small Expected
TEMPER (Table 2.79)								
Wide Neckbanded	251	69% sandstone	2x3	1.064	2	.588	.065	-
Narrow Neckbanded abc	414	62% sandstone	3x3	18.539	4	.001	.207	-
Sandstone-trachyte	412	74% sandstone	2x5	21.394	4	.000	.222	-
Neck Corrugated abc	117	61% sandstone	2x3	8.467	2	.014	.260	-
Sandstone-trachyte	163	70% sandstone	5x2	7.015	4	.135	.203	1 cell <5
PII Corrugated abcd	687	71% sandstone	3x4	30.010	6	.000	.205	2 cells <5
PII-III Corrugated	146	78% narrow coil	2x3	9.057	2	.010	.242	-
PIII Corrugated	62	82% sandstone	2x2	.130 (C)	1	.718	-	-
SITES (Table 2.80)								
Wide Neckbanded B,C,D	242	63% wide clapboard	2x3	-	-	-	-	-
Narrow Neckbanded BCDEF	507	53% 29SJ 627	4x5	58.829	12	.000	.322	3 cells <5
Neck Corrugated BCD	176	55% 29SJ 627	3x5	19.788	8	.011	.318	2 cells <5
PII Corrugated DE	816	58% 29SJ 627	2x4	12.372	3	.006	.122	-
PII-III Corrugated DE	166	80% 2-5 mm coil	2x3	2.842	2	.241	.130	-
PIII Corrugated DE	73	-	2x2	1.220 (C)	1	.270	-	-

(C) Indicates chi-square corrected.

Key:

Tempers:	a	Undifferentiated sandstone
	b	chalcedonic sandstone
	c	trachyte
	d	trachyte and sandstone

Sites:	A	29SJ 299
	B	29SJ 629
	C	29SJ 1360
	D	29SJ 627
	E	29SJ 389 (Pueblo Alto)
	F	29SJ 633

sort of patterning, including "festoon coils" in surface manipulation relatively more often than do the sandstone-tempered ceramics. Although there are only three examples of patterned corrugation in the Pueblo III Corrugated sample, all have trachyte temper, but the small Pueblo III trachyte sample contains relatively more wide coil specimens than does the sandstone group.

More corrugation patterning in the trachyte group may represent greater effort at potter identification, and the presence of fewer vessels with wide coils might indicate a greater skill level among Chuskan potters (Table 2.79). Still, percentages of narrow (2 mm to 5 mm) coil pieces in both major temper groups are similar. In all types but narrow neckbanded, the trachyte-tempered groups are slightly more diverse in surface manipulation than is the sandstone group (Table 2.82). Some of these surface manipulations may represent subgroups of producers that must have existed in both of these temper types. Identifying them will require more detailed analyses of materials, decoration, and vessel morphology. The corrugation patterning in trachyte pieces and the wide-coiled sandstone group confirm the presence of variability in vessel production, but the single outstanding characteristic of the assemblage is the across-temper similarity of 70 percent to 80 percent of the Pueblo II and Pueblo II-III vessels.

Chalcedonic sandstone, a potential check as an isolated producing area, is somewhat erratic across types. In narrow neckbanded and neck-corrugated, percentages of surface treatments are quite similar to those of the sandstone temper class, with a lower overall percent of patterning. In Pueblo II Corrugated, the chalcedonic sandstone groups show the highest percent of patterning. Although patterned trachyte cases are evenly split between Pueblo Alto and 29SJ 627 (giving Pueblo Alto a higher relative frequency), 7 of 9 patterned chalcedonic sandstone cases are from 29SJ 627. The sample is too small, but perhaps we are glimpsing the development of a site-area association late in the production of chalcedonic sandstone utility ware. This may even be a continuation of a relationship that existed earlier at nearby 29SJ 629.

Significant differences in grayware surface manipulations among sites are present (Table 2.81). The types identified here lasted longer than the peak popularity phases of some of the attributes recorded, especially in the earlier types. The time spans of 29SJ 629, 29SJ 1360 and 29SJ 627, are such that each site has examples of earlier and later vessels of the abundant types, and it is difficult to determine whether within type differences are temporal, site preference, or production effects (McKenna and Toll 1984:218-219).

If the sequence 29SJ 629, 29SJ 1360, 29SJ 627, 29SJ 389, and 29SJ 633 (with overlap) is valid, there are some trends that probably have temporal basis. Coil widths and, to a lesser degree, the presence of banding versus clapboarding, change with some predictability through time (Blinman 1984). Additionally, 29SJ 629 shows more wide coils and less clapboarding in wide neckbanded than the expected in a comparison with other sites, while 29SJ 1360 shows more clapboarded specimens. Narrow neckbanded at 29SJ 629 also contains a relatively high percentage of bands greater than 5 mm wide. Compared to the expectation set mainly by the large 29SJ 627 sample, 29SJ 1360 has more narrow neckbanded with wide banding than "normal," but less than 29SJ 629. Both of these occurrences seem likely to relate mostly to time of occupation and manufacture, but the very high relative frequency of wide coils in neck-corrugated at 29SJ 629 suggests that use of wider fillets by the suppliers of 29SJ 629 ceramics may have been traditional. At 29SJ 629, which has high relative frequencies of chalcedonic sandstone, nearly half of the neck-corrugated with wide coils has chalcedonic sandstone. Though 29SJ 629 accounts for only 21 percent of the neck-corrugated sample shown here, it accounts for 71 percent of the chalcedonic sandstone-tempered pottery with wide coils. Perhaps there was some specific producer-consumer relationship between chalcedonic sandstone-using potters and 29SJ 629 (Toll 1984). The numbers of chalcedonic sandstone-tempered Pueblo II Corrugated are trivial at most sites, but 29SJ 629 and 29SJ 1360 remain high relative to other sites, in wide coiled chalcedonic sandstone-tempered specimens.

The narrow neckbanded from Pueblo Alto stands apart as having a very high percentage of narrow clapboard (this frequency contributes very substantially to the significant chi-square Table 2.81). This probably results from the more uniformly late

Table 2.82. Surface manipulation diversity for types with more than two major categories.[a]

	Sandstone	Trachyte	Total
Narrow Neckbanded			
Diversity (H')	1.346	1.321	1.356
Evenness (J)	.837	.821	.843
Richness (s)	5	5	5
Neck Corrugated			
Diversity (H')	1.471	1.510	1.487
Evenness (J)	.914	.938	.924
Richness (s)	5	5	5
PII Corrugated			
Diversity (H')	.860	.885	.919
Evenness (J)	.620	.639	.663
Richness(s)	4	4	4
PII-III Corrugated			
Diversity (H')	.556	.715	.652
Evenness (J)	.506	.651	.593
Richness(s)	3	3	3

[a] See Tables 2.79 and 2.80.

date for the Pueblo Alto narrow neckbanded and from the higher frequency of trachyte there. A similar preference for narrow coils in Pueblo II Corrugated at Pueblo Alto may be observed, although the difference from the other sites is not substantial. The main element in the significant difference between 29SJ 627 and Pueblo Alto Pueblo II Corrugated stems from more wide coils in the 29SJ 627 collection. Not surprisingly, the great majority (74 percent) of this group is sandstone-tempered at 29SJ 627. There may be an additional production group represented here, but as with the production relationships above, these are merely suggestions. It is notable that there is no significant between-site difference in grayware surface manipulation in the two latest types. This is in part because in Pueblo II, Pueblo II-III and Pueblo III, 72 to 85 percent of the cases have single surface treatments. Differently constituted tests on surface and other attributes of neckbanded ceramics from 29SJ 1360, 29SJ 627 and 29SJ 629 also show some site-design association, again based largely on minor surface treatment categories with an overall background of site similarity (McKenna and Toll 1984:221, 486-487).

Although there may be meaningful variable states of which we are unaware, this reduction in surface treatments may have considerable relevance to the production of pottery. Superficially, reduction in surface treatments from narrow neckbanded and neck-corrugated onward fits beautifully with the model of reduced variability with increased specialization, but several contradictions to such an easy fit must be considered before it can be accepted. The widespread homogeneity in appearance of early grayware (Lino Gray) and the small number of surface attributes in wide neckbanded must be attributed either to some cause other than specialization and standardization, or to some cyclical presence of restricted production. The fact that in the types with many surface treatments, most of those treatments occur in all temper categories, also demands explanation. Finally, the metric results do not seem to be in simple agreement with such an explanation. That is, in some instances, the metrics show increased variability; in other cases they do not, and the multivariate classification success improves through time.

The improved classification success may show more specialized production. It may be that the regional interaction or, in an extreme formulation, social control, increased during the production of Pueblo II-III and Pueblo III Corrugated to the point that specialized producers were making stylistically similar ceramics. The statistics for Pueblo II-III Corrugated, including its high percentage of trachyte and tight time range, are the most supportive of this trend. It is peculiar, though, that Pueblo III should follow suit because some specimens in this group come from considerably later, but also because this type shows an increase in metric variability. We have argued that the period during which Pueblo III Corrugated was produced was one of disruption in many aspects of the system (Toll et al. 1980), which fits with the increased metric variability, but not with the reduction in surface manipulations.

Longacre et al. (1988) conclude that the search for standardization will be difficult or impossible without having the folk taxonomy of vessel forms to test for consistency (see also Stark 1995). In their studies in the Philippines, vessel categories are based on size and other criteria. The metric mixture of different categories shows that size is not the only criterion, but lacking any other, it was used to look for subgroups in grayware jars. Histograms of rim diameter in Pueblo II Corrugated (the largest group) look like normal distributions centering around diameters of 200 mm to 210 mm (histograms of all measurements show that estimates ending in zero [e.g., 200] were used much more often by the recorders than those ending in five [e.g., 185]; when combined into 10 mm increments an apparently jagged distribution becomes quite smooth). To look for increased standardization within subgroups, three size groups were defined based on the size distribution: small—less than 165 mm diameter, medium —165 mm to 280 mm diameter, and large—greater than 280 mm (Table 2.83; Figure 2.24). Variability within size-temper groups (as measured by the coefficient of variation) is quite similar from type to type. Trachyte CVs tend to be slightly smaller than the others and the chalcedonic sandstone CVs, slightly larger. The groupings also show that there are usually more trachyte-tempered vessels in the large category than other tempers. Dividing the types into size and temper groups, then, reiterates other findings; at the level of resolution available to us, we can see suggestions of increased uniformity and perhaps competence among Chuskan potters, but their work is not sufficiently different from that of other artisans to be clearly distinct.

Data Summary and Interpretation. The results of the above analysis may be summarized as follows:

1) The temper groups, which are assumed to represent areal sets of producers, show a great deal of similarity through time. This similarity encompasses size, rim measurements, and primary surface decoration. The significant differences that were found among groups are frequently based on attribute states that are less common in all groups. Multivariate analyses are able to place cases in the correct temper group more than half of the time, but there is consistently a large number of misclassifications; the correct classification percentage is sometimes accomplished through placement of all cases in the most abundant group. This fact and the infrequent showing of temper as a significant variable in classification support the univariate analyses. Grouping of whitewares, based on different attributes from the grayware study, also shows that the majority of pieces fit into one group and that similarities cross-cut suspected production groups (Toll and McKenna 1987, 1992).

2) There are, however, differences in variability among groups, and there is some tendency for these differences to recur through the types. In particular, the trachyte group quite consistently shows less metric variability, although there is more surface diversity in trachyte in narrow neckbanded through Pueblo II Corrugated. That there are some multivariate classifications supports the idea that some metric distinction is present, although apparently not a strong one.

3) The volume of ceramics brought to Chaco Canyon from elsewhere was substantial. This is best seen in trachyte-tempered graywares, but other groups of imported ceramics are present and some members of the sandstone-tempered group, which, conservatively speaking, may be local, are also likely to be imports (Import Section).

4) In the same vein as (3), there are likely to have been multiple producers supplying ceramics to Chaco Canyon. Although the present temper analysis results in three substantial grayware temper cate-

Table 2.83. Rim diameters and coefficients of variation within size-temper groups.

Temper	No.	Mean	CV
PII Corrugated small	131	131.6	18.5
Sandstone	76	132.6	19.6
Chalcedonic sandstone	5	132.1	24.9
Trachyte	43	131.7	15.9
Trachyte and Sandstone	7	133.6	20.4
PII Corrugated medium	505	218.6	14.2
Sandstone	235	217.6	14.1
Chalcedonic sandstone	33	211.2	15.2
Trachyte	215	221.0	14.2
Trachyte and Sandstone	22	217.7	13.6
PII Corrugated large	60	313.0	6.2
Sandstone	24	313.3	6.2
Chalcedonic sandstone	5	308.0	5.2
Trachyte	27	313.9	6.1
Trachyte and Sandstone	4	311.2	9.7
PII-III Corrugated small	36	133.3	22.5
Sandstone	22	133.4	23.2
Trachyte	13	137.3	19.2
PII-III Corrugated medium	137	222.1	13.5
Sandstone	59	221.0	14.1
Chalcedonic sandstone[a]	3	205.0	
Trachyte	64	221.7	12.9
Trachyte and Sandstone	11	234.5	11.2
PII-III Corrugated large	18	315.3	7.2
Sandstone	4	305.0	4.2
Trachyte	13	320.4	7.4
PIII Corrugated small	37	118.6	19.7
PIII Corrugated medium	42	205.1	12.9
Sandstone	22	197.3	11.0
Trachyte	16	216.9	13.2
PIII Corrugated large[a]	3	320.0	

[a] n is too small for meaningful standard deviation so no CV is shown..

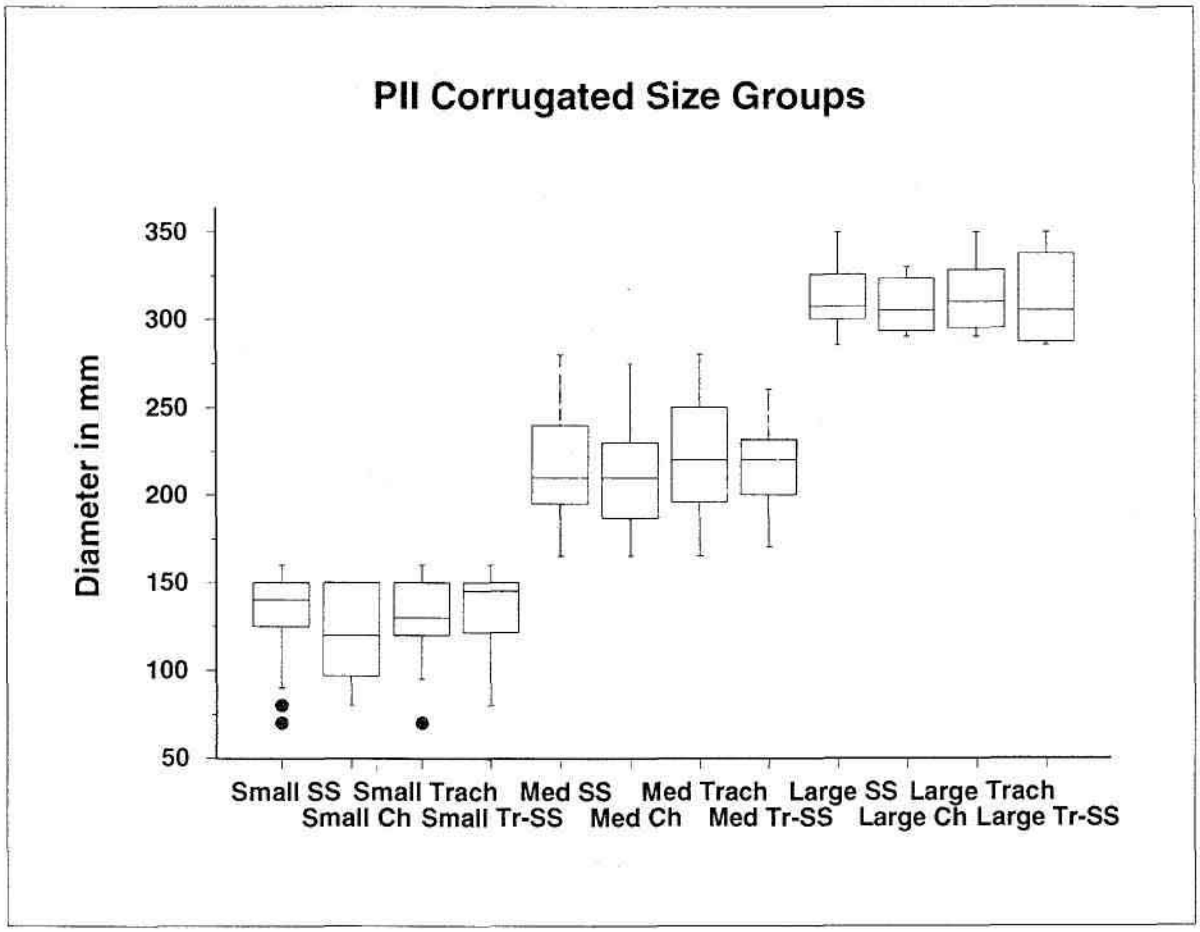

Figure 2.24. Box plots of size-temper group diameters in Pueblo II Corrugated. SS=sandstone, Trachy=trachyte, Ch=chalcedonic sandstone, Tr-SS=trachyte-sandstone mixed; small, mdium, large refer to vessel size groups. Total n=692; Small Ch, Small Tr-SS, Large Ch, and Large Tr-SS each has less than 10 cases.

gories, each of these is quite likely to represent many producers at any given time. This is, of course, most applicable to the largest and vaguest category, undifferentiated sandstone. Evidence for several producers within these larger groups includes the following: a) metric variability within groups; b) surface treatment variability, such as wide coils in sandstone and patterned corrugation in trachyte; c) refiring that shows different clays within temper groups (Temper and Paste section; Toll et al. 1980; Toll and McKenna 1987); d) temper variability within sandstone (grain size) and chalcedonic sandstone (color of chalcedony matrix) and quantity of sherd temper; and e) clay body difference. Some of all of the above may be temporal or idiosyncratic variation, but some must represent multiple producers.

5) There seems to be a period of greater variability covered by narrow neckbanded and neck-corrugated (ca. A.D. 900 to 1050), but by our criteria there is considerable consistency before and after that time.

6) There is temporal decline in variability, with the least variability most visible in Pueblo II-III Corrugated. This is of considerable interest because Pueblo II-III Corrugated corresponds most closely with the fullest extent of the Chaco system and the

most pronounced relationship with the Chuska area. Volume, variability, and distance all make a good case for specialized production. This case is mitigated somewhat by relatively greater diversity of surface treatment in the Pueblo II-III Corrugated trachyte-tempered group than in the sandstone group.

7) As suggested by (1), change occurs across temper groups in a remarkably consistent way. This change occurs on a very broad, virtually pan-Anasazi, scale. Because the scale of these changes is critical context to viewing consistency within region vis-a-vis specialization and because deciphering its cause would provide something really fundamental about Anasazi systems, further discussion is warranted.

Broad-based Ceramic Shifts and their Relevance to Specialization

The Anasazi ceramic sequence contains several examples of dramatic (ceramically speaking) changes. One is the change from mineral to carbon paint (Table 2.6; Type Descriptions; Toll 1985:216-223; Wilson 1996). Others are the change in vessel form from Lino jars with necks and tecomates (both with small orifices) to the wide-mouthed jars that followed, changes in exterior manipulation of graywares, abandonment of fugitive red treatment of vessel exteriors, adoption and rejection of vessel forms (such as gourd ladles, pitchers, kiva jars, mugs), and decorative changes such as that from Red Mesa designs to Gallup designs (Appendix 2A). Smith (1971:611-612) discusses a similar, later shift in the rapid change from orange to yellow wares. There is little information on the time frame for such shifts or on their synchronization over large areas, but typological dating suggest that they were rapid and relatively synchronous.

Good chronological control was available for Blinman's (1984) study of grayware neck coil width in the Dolores Area which shows a period of rapid change between A.D. 860 and A.D. 890. A similar trend in neckband width reduction is present in Chaco Canyon, with a typological break-point between wide coils and narrow ones placed at A.D. 900. The Chaco date is not entirely independent from the better-dated Mesa Verde area (Breternitz et al. 1974), and Blinman has used minimum coil width values well below dated provenience means to define the trend. The ranges increase greatly through time in the study (Blinman 1984:131-132). Some of this increase is surely the result of curated pottery, but it seems likely that the use of only the narrowest examples exaggerates the trend. Still, as noted in the Chaco type comparisons (which are similar in concept to Blinman's use of "progressive sherds"), the early types show less variability in some attributes than do the later ones. Thus, the typological framework suggests that variability was low early. Blinman has controlled for local production in his study and this temper is virtually absent in comparable types from Chaco Canyon, showing similar shifts in well-separated areas at the same time.

Equal in scale and fundamentality to changes in grayware surface treatments is the change to use of carbon (or organic) paint on whitewares. East of the Chuska Valley (and even in parts of the valley) and from Dove Creek to Silver City, whiteware pottery was painted with mineral-based paint from before A.D. 900 to late in the A.D. 1000s. These temporal and spatial spans are remarkably similar to the period of the greatest energy investment in Chaco Canyon and to the area of the Chaco system in the larger sense. Around A.D. 1100 mineral paint was largely replaced by organic paint. This change had some precursors in the latter A.D. 1000s, as organic paint was used with increasing frequency, but the majority of the change is around A.D. 1100 (Tables 2.6, 2.7). Percentages of carbon paint shown in the post A.D. 1100 segment would be higher were it not for the significant heirlooming effect that is inevitably present. With the exception of a few pockets of mineral paint use, by A.D. 1200, nearly the whole area that formerly used mineral paint had changed over to organic paint. The early A.D. 1100s mark a number of major changes in life in Chaco Canyon. Building events are scaled down, changing from large rooms and classic Chaco greathouses to "McElmo" style buildings (Lekson 1984a). By A.D. 1130, acquisition of new beams and most or all large building efforts have ceased, additions to the "trash mounds" ceased, and there was a shift in residence pattern at greathouses (Windes 1987). The use of hachure in ceramic design was greatly reduced and more obsidian and less Chuskan ("Washington Pass") chert (Cameron 1984, 1987:267-269) was in use.

This was clearly a time of important organizational change in Chaco Canyon, and within the eastern Anasazi world. When we have deciphered whether the ceramic changes that occurred at this time were coincidental with social change or directly related and how, we will have made a substantial contribution to understanding links between social change and material culture.

These rapid and apparently synchronous shifts in fairly major aspects of ceramic manufacture are surely an important piece of evidence for both productive and social organization, but exactly what they show is extremely problematic. The most parsimonious explanation in the present context is that there were, in fact, a limited number of potters so that the number of producers who needed to change to conform to a new style was small and a rapid change was thus possible. A limited number of potters with widely consumed products is, of course, only a facilitator to a rapid change, and we know that even if they were restricted in number, they were widely distributed in space.

The reasons a presumably conservative segment (see Foster 1965) of a reputedly conservative society should change on anything more than a highly localized or regional basis must rest in an organizational realm rather than a purely technological one. Proponents of powerful hierarchical control can find support for that position in phenomena like these, which have parallels in architecture. Indeed, attributing wide-range change to a decision made by authorities is another parsimonious and more complete explanation than others available. Because of the date of either the Lino form change or the neckbanding change, for example, using authoritative direction as an explanation requires that considerable differentiation was present quite early, and Schelberg (1982) has argued for simple chiefdoms in Basketmaker times. F. Plog's concept of "alliances" is concerned with wide areal similarities such as these (Cordell 1984a:320-321; Upham 1982). Alternatively, rather than an expression of political control, style may be a means of identifying group membership. Such identification is an adaptive response facilitating interaction in an unpredictable environment (Gillespie 1985; Schelberg 1982), an explanation developed for ceramics by S. Plog (1980c) and others.

The ready adoption of functional improvements must also be considered as a cause for these shifts, although differences in exterior surface treatments or rim forms of graywares are difficult to accord the status of revolutionary improvements (see Young and Stone 1990). Possibly it was discovered that a textured exterior and a smooth interior surface reduced vessels' susceptibility to thermal shock (Schiffer et al. 1994:207-211). The adoption of some treatments is especially intriguing in that some, such as corrugation, may have translated into increased production effort (although E. Blinman [personal communication 1995] has found it possible to rapidly produce corrugated jars). There may also be functional reasons for the switch from mineral to organic paint. Given sufficient control of firing atmosphere, organic paints require lower temperatures for successful binding of paint to pot than do mineral paints (E. Blinman personal communication 1996). Mineral paints are more forgiving of atmosphere control problems; thus, with improvements in firing atmosphere control and identification of slips that would retain organic paint it would have <u>theoretically</u> been possible to conserve fuel by using lower firing temperatures. This suggestion has appeal, given arguments above that fuel was a limiting factor in pottery production, although Blinman also points out that many carbon-painted whitewares appear to have been fired at temperatures similar to mineral-painted ones. Perhaps carbon paint was just energy efficient because it eliminated the need to grind mineral pigment.

Much as we might wish for functional, efficiency-based explanations for the shift to carbon paint or grayware manipulation, the extent and timing of the changes suggest additional, social reasons for them. The broad scale changes in ceramics, particularly in putatively inconspicuous graywares, carries an important, if cryptic, message about communication and connectivity among Anasazi regions. Although change would have been facilitated by the presence of specialized producers, specialization in and of itself seems inadequate to account for the breadth and thoroughness of these changes.

<u>Level of Specialization.</u> In the above analyses of graywares, the discernible variability in decoration and measurements is repeatedly overshadowed by similarity across groups. Whitewares also follow this pattern. This lack of clear differentiation in the major classes of pottery in Chaco Canyon is critical in estimating the sort of "specialization" that might have existed in the system. Placing production on the dimensions defined by Costin and Hagstrum (1995), San Juan Basin ceramic specialization can be characterized as follows:

> **Context of production.** There is no reason to suspect that pottery producers were "attached" to elites for the production of specialized forms, since even the most unusual of forms (effigies, cylinder jars, perhaps shouldered pitchers) share technological and technical attributes with the most abundant.
>
> **Concentration and constitution of production.** Temper makes it clear that production took place at numerous locations; the regularity of many vessels and the apparent areal specialization on some forms suggest that not all households produced pottery, or at least that some produced pottery in excess of their own needs.
>
> **Intensity of Production.** There is no way to judge whether ceramic production was seasonal, or how much time even the most productive of communities spent making pottery. Seasonal conditions are sufficiently variable that it is unlikely that pottery was made during the coldest months because of freezing and drying (too slow) problems (December and January, perhaps), and perhaps during the windiest months (April and May) because of firing and drying (too fast) problems.

In Costin and Hagstrum's (1995:621) terms, production circa A.D. 1100 seems likely to have combined individual specialization (uniformly dispersed autonomous households producing for local consumption) and, perhaps, community specialization ("autonomous individual or household-based production units, aggregated within a single community, producing for unrestricted regional consumption").

Different wares were distributed at different scales in different areas. San Juan Redware and later White Mountain Redwares were produced in areas that were much smaller than the area to which they were distributed, as were Polished Smudged (Hegmon et al. 1995). Chuska graywares, and probably others, were produced beyond the need at the place of manufacture, but not as widely distributed as the red and smudged wares. Whiteware production and distribution were probably similar to the graywares in the San Juan Basin, although the evidence for their movement is less clear, and they may have even been transported at lower levels than the graywares. Whatever the relative quantities of movement, the evidence for production beyond need indicates low level specialization from early in the Anasazi sequence (see Wilson and Blinman 1995). Because of the complex relationship between standardization and specialization, the two cannot be equated (Hegmon et al. 1995:34, 53; Stark 1995), as indicated by the findings for graywares here. Contrary to the findings of Hegmon et al. for redwares, the Chuska graywares do seem to be slightly more regular than other graywares; combined with the large absolute quantities indicated, community specialization is strongly indicated.

Balfet (1965, 1981) places great emphasis on the diversity of producers present in the Maghreb. In this large area, there are household producers and "semi-specialists" who produce similar wares in similar ways and there are artisans or specialists who produce technically different and distinctive pottery. Although the levels of difference are difficult to compare with Chaco Canyon, it seems safe to say that there is no class of very distinctive pottery in Chaco Canyon that is comparable to that found in the Maghreb. Rare and unusual vessel forms fall well within the technological range of much more common forms. The coexistence of two levels (household and semi-specialist) producing in the same basic fashion is quite easily postulated for Chaco, however, because the two are highly similar in the Maghreb (Balfet 1965:162-171). There is some standardization from the earliest levels of specialization (Balfet 1965:171), and this is presumably part of what has been ascertained here. Balfet describes 2000-year stability in decoration and technology among domestic producers. Although specialized producers have strong traditions in decoration and form, they have changed more rapidly than domestic producers (Balfet 1965:169). Change in Anasazi ceramics was more rapid than in the Maghreb. This greater rate of Anasazi change suggests a level more specialized than purely domestic production.

Specialization at the Lower End.

> The classic type of Hopi education makes the economic specialist practically nonexistent. Each child is thoroughly trained in all the conventional activities associated with its sex, though it is inevitable that some individuals for one reason or another stand out in the community as possessing greater skills than the average... (Beaglehole 1937:19).

> All the finer baskets are purchased from the Apache, Hopi, and other Indians. Those of the former are especially prized. It is not that the Zuni women cannot make the fine baskets, but it happens in aboriginal life as in other civilizations that different people have their specialties and objects of foreign manufacture are prized (Stevenson 1904:373).

These quotations illustrate two points about specialization that must be recognized in this archeological quest for its definition:

1) Individuals who could be considered part-time specialists are likely to occur in any group above some rather minimal size.

2) In an area such as the Southwest containing numerous communities, whether of the same or different "cultures," there may be development of group craft specialization even if some of the groups involved are nominally egalitarian (if not the Pueblos then the Apaches).

Beyond a very few individuals, it is very unlikely that full time specialists of any sort were present in the twelfth century San Juan Basin—full time specialists were uncommon even in the Aztec state (Brumfiel 1987:109, 116-117). Granting that some individuals are likely to devote more time than others to some pursuits in almost any social organization, we must inquire as to the point at which these time expenditure differences among individuals promote differentiations in power. Practically any group has an individual who is some form of ceremonial specialist. Such ceremonialists can be present with minimal occupational differentiation among the rest of the group. One of many unquantifiable unknowns is the extent to which a ceremonial or a ceremonial-cum-administrative specialty can exist without other specialists to support it.

To what extent could ceramic part-time specialists exist without other productive specialties also being in place? Brody (1977:1-3) expresses considerable surprise that people living in simple villages in the Mimbres area could have produced the high art form that their pottery represents. Perhaps a few specialists (LeBlanc 1983:138) can exist with minimal implications for other pursuits.

While there were probably ceramic, hunting (Akins 1982a,b), and jewelry specialists (Mathien 1984), in the Chaco sphere, there is little evidence for lithic specialists (Cameron 1984). While there are cases of possible administrative specialization (Akins and Schelberg 1984), they are few; and while layouts of large Chaco sites clearly exhibit planning, construction need not have been overly consumptive of time and energy (Lekson 1984a,b). Thus, specialization probably consisted of some occupational differentiation including some individuals who did not engage in any material production. This is a level greater than that described above by Beaglehole, but not a great deal. It is questionable whether the relationship between administrative specialists and productive specialists was such that enough "wealth" could be diverted to create a coercive power base (Sebastian 1992; Wilcox 1993).

There have been suggestions that the prehistoric pueblos were differentiated to the extent that there were big men (Lekson 1984a:265), ranked societies (Schelberg 1982), self-serving elites (Sebastian 1992), oligarchies (Upham 1982:20, 199), and military polities and a Chaco state (Wilcox 1993). Although Lynne Sebastian (1992) understands me differently, I acknowledge that some individuals must have had greater access to knowledge and control over distribution of resources. I also continue to think that the ethnographic record suggests and the archeological record supports the idea that these "leaders" were meant to be heard but not seen. Wilcox discusses individualizing and group-oriented chiefdoms. Group-oriented organizations include difficult-to-identify leaders, part-time specialists, periodic communal redistribution, impressive group monuments, and emphasis on group activities (Saitta 1997; Wilcox 1993:Table 1). If these individuals were supposed to have low visibility to their contemporaries, what chance does an archeologist have of identifying them? By their deeds perhaps we shall know them; it is less likely we will know them by their houses (or their burials).

Community specializations have the overall effect of integrating regions with all the symbiotic advantages that have been attributed to such integration (see also Hagstrum 1995:289-290). Much as there are benefits beyond those expressed by practitioners for religion (broadly as Harris 1974), prizing "objects of foreign manufacture" carries the adaptive advantage of maintaining economic relationships with diverse areas and groups. Community specializations occur in a dramatic way in densely populated, markedly differentiated situations such as Mesoamerica, but also in less complex cases. While the degree of specialization apparent might fit within a complex social organization, the complexity did not approach that of modern or ancient Mesoamerica.

The distinction noted by Hagstrum (1985:68) between specialists who produce to participate in an exchange network ("general specialists") and those who supply and are supported by an elite ("attached specialists") is relevant here. As she suggests for the Rio Grande area, what specialization can be discerned in the Chaco case seems very likely to be "general." Perhaps even more useful is the concept of the "embedded specialist" whose labor is "integral to the functioning of household and local economies" (Saitta 1997:9). Efficiency may be one reason for vessel similarities, although Hagstrum's emphasis on time-saving seems based on the industrial age, and mass production is unlikely to have existed (see Stark 1995). As noted, some changes in Anasazi ceramics may or may not have been efficient for production. Other factors may be advanced.

Other Sources of Standardization.

The Functions of Vessel Identifiability.

The appearance of a pot provides information of varying specificity about where it was made and who made it. These visual cues, in turn, contain a great deal of potential information as to scale and type of social relationships and about production and consumption (Plog 1980c). On the most inclusive level, Anasazi pottery was and is readily identifiable. There is more to this level than merely "if it is pottery it must be Anasazi," because throughout the Anasazi sequence there are design and form changes that are found throughout the area. This level of group identi-fication is, perhaps, the most fascinating one because of its scale. Its significance is also the most difficult to plumb. While pancultural similarities have continued to the present, it can be said (and argued interminably, no doubt) that through the eleventh to twelfth centuries this similarity was greater than in later centuries even though the earlier areal extent was greater (Toll et al. 1992). Plog (1980c:126-128) places these wide similarities earlier at ca. A.D. 500 to 900, and regional differentiation does increase through time (e.g., Danson 1957:92-93). Similarities recur at the same scale in other technologies and their recognition provides important context as ever finer divisions are attempted.

During the time when the Chaco system was in full operation, several regional wares were being produced. Three redwares were produced in different areas and several variations on the black-on-white and grayware themes were in production. Plog (1980c:115-119, 134-141) makes the argument that the development of regional styles functioned to transmit information about group membership, which facilitated symbiotic interactions. While this explanation has some appeal, it also has some problems. Any sizeable Southwestern ceramic collection contains significant numbers of vessels from numerous regions, making the group identification message contained in one's pots unclear, or at least complex (Kramer 1985:88). How useful is pottery in proclaiming one's group identity in situations where one's identity is unclear? It seems unlikely that one would have one's pots along in such situations.

Moreover, as has been pointed out by anyone who has typed ceramic collections, there is regularly ambiguity among types and even series which are, after all, based largely on visual identifications (Swarthout and Dulaney 1982). Thus, while stylistic and technological variation clearly contain group information, the contexts in which that information was valuable is entirely speculative. Because of the fact that ceramics were widely exchanged, there are alternative interpretations:

1) With specialization, areas and individuals may have become known for producing ceramics with certain qualities making identification of vessels' makers useful information to someone acquiring vessels.

2) Possession of vessels clearly from other areas is symbolic of interareal cooperation and coexistence.

3) At the highest level, sharing forms and symbols across wide areas also may have signified the recognition of the beneficial aspects of maintaining relationships with those of similar adaptation, subject to similar vicissitudes, over as broad an area as possible. This interpretation helps resolve an inconsistency in Plog's application of "information exchange theory." That is, while Plog attributes group membership information to ceramic design when regional differentiation developed, this function is not attributed to the early period ceramics when widespread similarity is especially notable. Setting aside the reservations expressed about how effective a symbol pottery is, it is still unclear why it was a symbol at A.D. 1100, but not at A.D. 900. Rather than a change in meaning having taken place, a broad-based expression of similarity would have had continuous adaptive utility. As population grew and niches filled, between-group relationships probably became more competitive, but the adaptive reasons for intergroup interaction clearly continued, as did the higher level symbolism of widespread ceramic similarity.

At the regional and subregional levels, many of these same reasons for the ability to identify vessels apply, although at a more specific level. Identifications of the products of a village, clan, family, or individual could have served to place a vessel into value and function categories, as well as being evidence of social and economic relationships. As shown, the Chuska area provided large quantities of ceramics found at Chaco; the majority of those ceramics are utility wares and the volume and relative consistency of those vessels make them the tightest case for specialized production. While providing quantities of grayware to Chaco, the Chuska area maintained a distinctive whiteware series throughout, having slip and especially paint that are different from the majority of the whitewares found in Chaco Canyon. Carbon-on-white Chuska wares are found in Chaco Canyon, but never in percentages of the magnitude of the Chuska Graywares (see Import and Temper sections). Whitewares that do correspond to the mineral majority in Chaco Canyon were also apparently made in the trachyte-tempering area, but some of the clay sources seem to be different from those for Chuska Gray and Carbon-on-white wares (Bubemyre and Mills 1993; Windes 1977; Toll and McKenna 1987; Zedeño et al. 1993).

Thus, at least some part of the Chuska area maintained a decorative technique more reminiscent of the region west of the Chuska Mountains than of the San Juan Basin, in spite of the Chuska Valley's heavy participation in the Chaco system. Perhaps, as Plog suggests, there was some effort by the Chuskans to set themselves apart. Chuskan Carbon-on-white does seem to have been moved differently from Chuskan Grayware (Mills 1986; Toll 1985). This case is a good illustration of the tension between similarity and participation on one hand and lower level distinctiveness on the other, confronting social interpretations based on ceramics.

The distinctiveness of the carbon-painted ceramics forming the majority of whitewares in the Chuska area (Windes 1977) lends emphasis to the second aspect of the ceramic relationship between these two areas—the decorative similarity of graywares throughout the macroregion. Plog's interpretation of this similarity is that graywares were kept in inconspicuous places. "It is those artifacts seen by more individuals that are most appropriate for the transmission of stylistic messages" (Plog 1980c:119). It may well be that grayware jars were less visible, but several points suggest that they should also be considered as group symbols:

1) Volume of importation. Demand for functional vessels may supersede stylistic identification.

2) Regular change in appearance. That attributes such as corrugation, neckbanding, and rim flare all changed through time shows that attention was paid to grayware appearance.

3) Utility wares functioned in socially important contexts. Food preparation is a fundamental part of most historic Pueblo ceremonies. Food was probably served in decorated wares, but utility wares would have had a crucial role in preparation. Preparation for Pueblo ceremonies is marked by thorough attention to correct detail. If pooled storage took place, it was surely socially important. If vessels were used for transport, they were likely utility vessels; and if vessels served as identification, it is in a transport situation that one is most likely to meet someone who wonders who one is. Given the public functions suggested for Pueblo Alto, the increased volume of grayware there further supports the idea of social significance for grayware.

The visual similarities among graywares provide a caution with regard to interpreting the differences archeologists identify among whitewares. As archeologists interested in the best possible provenance for an assemblage, we focus on technological details of paint type and slip, and clay and temper. Users of vessels choosing to be aware of these archeologically important attributes (eleventh century ceramic connoisseurs) could no doubt identify sources better than the best modern ceramic analyst. On the level of less discriminating users, however, color and design were much the same over an immense area, and the information received from vessels may have been more that a given vessel was "proper," rather than that the vessel came from a particular part of the region. In this context, the inclusiveness rather than the differentiation is important (Toll et al. 1992). There are many similarities in modern life—it is important to my son not only what team a team cap represents, but also what the make and type of the cap is. Less enlightened viewers (such as most adults) of hats only notice the team logo.

Reina and Hill's (1978) discussion of traditional utility pottery production in modern Guatemala contains many parallels to the Anasazi case. Utility wares clearly have great social significance in Guatemala and we now turn to an examination of the social processes involved with pottery's place in that system.

Costumbre

Much of the similarity that can be discerned across varying amounts of Anasazi space may have resulted from what is called costumbre in Mesoamerica (Diaz 1970; Nash 1966; Reina and Hill 1978: Chapter 9). It exists in villages elsewhere in the world as well (e.g., Nicklin 1971:29). As defined by Reina and Hill, costumbre is a pervasive observation of what is done and how it is done. It is a communally held definition of behavior relative to pottery production and distribution, as well as to social relationships and ritual observance. In Guatemalan Mayan communities:

> ...costumbre is applied to the overall community tradition. It appears as a forceful cultural concept that both coordinates and determines people's thoughts and actions... The producer, the middleman, the merchant and the consumer of traditionally made pottery are joined to each other as their respective roles are defined by costumbre...
>
> Levels of thinking and actions people find difficult to verbalize are attributed to costumbre... Merchants in the regional market carefully choose vessels of the forms and styles that correspond to the costumbres of the people they serve... Costumbre draws people together and maintains a definite subcultural boundary for their business [and other] activity...
>
> In closed corporate pueblos, costumbre encompasses all that is most permanent in the way of life; it is at the center of the community culture. As long as potters keep to costumbre, the quality of their vessels is sustained. Costumbre brings constant reaffirmation of established practices without intent or need to innovate. Costumbre in pottery-produc-

> tion centers brings social and economic stability (Reina and Hill 1978:231).

> For Indian potters, religion and economics are not separate categories. Rather, they have become one: there is religion in pottery making, in selling, and in all aspects of existence. For potters, all these things together constitute costumbre (Reina and Hill 1978:233).

Costumbre, then, serves as a powerful conservative force that is materially manifested in many symbols, including language, dress, and pottery forms. Important to the Chaco discussion is the locus of the control expressed in costumbre, and how the control develops. The operation of costumbre may be viewed on increasingly abstract levels. First is the conscious level exemplified in depth by Reina and Hill. Second is the level of the community itself and the major role that the community has in enforcing conformance to costumbre. Third, the operation of costumbre has adaptive effects: a materialistic level may be defined. Finally, the supra-community level must be examined for the extent to which extra-community context determines and maintains the institution of costumbre.

Is costumbre different from culture, and does it explain anything more than "culture?" The two overlap, although costumbre seems to me to be a more manageable subset of culture, especially in the cases presented. Rather than being an explanation, costumbre is an empirically demonstrated mechanism of control; it provides a description of how standardization can be maintained.

For its practitioners costumbre has an existence of its own; it is an almost concrete, ideally immutable entity.

> Pottery-making is not thought of as a vocation to be learned in school or through lessons; it is a destino (a fate), and it is particularly the destino of certain families in Tonalá (Diaz 1970:179).

> ... most potters tend to think of particular vessels [i.e. vessel forms] as things that are, not as objects which one can adapt (Diaz 1970:178; emphasis in original).

At the conceptual level, then, one follows these forms because that is the way things are done and there is little other choice.

Various accounts of this process indicate that most of the social mechanisms necessary to the maintenance of costumbre may be found in the community or region. There is little or no mention of enforcement by authority. Nicklin (1971:31-33) gives multiple examples of how "diffuse negative sanctions" operate to encourage potters to conform to traditional products. In his cases, there are no uses of force; the pressures all take the form of public opinion. In more extreme cases, including the Pueblos of the Southwest, accusations of witchcraft can arise, which can result in physical harm to the accused (Darling 1993; Siverts 1969:113).

Costumbre has economic and adaptive (or should that be selective?) effects. For the community as a whole and especially for potters, the established forms constitute an adaptation that works. As in biological evolution, there is a resistance to changing an existing adaptation. Wobst and Plog (Plog 1980c) stress that group identification facilitates interaction with other groups, whether economically or socially. Reina and Hill's (1978:Chapter 9) discussion of the economics of Guatemalan pottery graphically back up Wobst's more theoretical treatment (also Siverts 1969; Nicklin 1971). Foster (1965:49-51), in examining why potters tend to be especially conservative, points out that pottery-making is subject to a fairly narrow set of technological limits. When the established formula is followed carefully and skillfully, a successful result is predictable. Changes engender unnecessary risks. Potting will change in response to economic stimulus, but the overall picture is conformance to established practices of the group.

If there are other reasons for this type of areal consistency, is control beyond this community level necessary? Nicklin (1971:29) says potting groups pertain "more to peasant than to tribal potters." By definition, peasants are a largely agricultural working class, subordinate and paying "rent" to another, wealthier class (e.g., Cook and Diskin 1976:11-12; Roseberry 1976:47; Wolf 1966). According to Wolf (1966:3-4, 10), the primary difference between "primitive cultivators" and peasants is that peasants do not control their means of production nor their surpluses. The Mesoamerican examples given here fit into this category. Siverts (1969) shows that a major aspect of costumbre-based "boundary maintenance" in Chiapas is that the Indian peasants maintain their community ties because the socioeconomic environment is such that their community is the only place a secure, successful way of life is likely. Land is the basis for production and status and only through correct community behavior can one maintain one's access to the land (Siverts 1969:112-114). Acquisition of land or means outside the community is highly unlikely. Nash (1966:32-33) maintains that for redistributive economies to exist, there must be "social differentiation along some axis of prestige and power inequality" and that in mobilization economies (more like those cited here involving costumbre), the difference becomes more emphatic and wealth is more directly controlled by the elite. A higher social order is present in these cases and has some effect, but that effect is not directly observable even in these living cases.

The historic pueblos manifest many aspects of costumbre, both socially and as expressed in ceramics. There is a strongly developed ethic of suppressing individuality among the Pueblos (Ortiz 1972:153-154), as well as one for following established, traditional behavior.

> To do things as one's tribe does them is to fit with the in-group, and to make pottery like that of another tribe, or to otherwise copy another group is to be not only 'odd' but so traitorous that in the modern period, for instance, attempts have been made to cast a potter out of a tribe into which she had married, only because she tried to continue making the pottery of her home group (Ellis 1974:231).

Modern pueblos correspond to peasant economies in many ways as well; perhaps, these attitudes have some basis in conditions such as those analyzed by Siverts. Today, it is possible to identify the pottery of individual pueblos, or at least of very closely spaced ones (e.g., Santo Domingo-Cochiti, the Hopi Villages, or Santa Clara-San Ildefonso). These areas are smaller than those recognizable at present in the Anasazi ceramic record, and the scale of areal definition seems to have decreased through time (Cordell 1984b).

For four centuries the pueblos have been subject to many of the social and economic conditions experienced by Mesoamerican communities, but ceramic distinctions existed long before contact. Costumbre on a fairly local level is probably sufficient to account for the degrees of standardization in ceramics evident in these analyses, especially if some communities and individuals produced more pottery than others. Does this mean that prehistoric potters were peasants subject to "rents" by land controlling elites? If costumbre without hierarchical control of production suffices to account for pottery variability, can costumbre be accounted for without stratification?

The similarities between peasants and cultivators in control of their "surpluses" suggest that some form of costumbre could exist in the absence of exploitation. Unquestionably, there were costs for participating in the Chaco system, but return to the cultivators could have been high in time of need. That there was some form of "payment" to a larger entity than the community increases similarities between Chaco and ethnographic situations with costumbre, regardless of who was the ultimate beneficiary.

Varying approaches have been taken to account for some aspects of the ceramic phenomena at issue. Plog (1980c) uses a largely environmental explanation for the development of styles. That is, he argues that the conditions of population growth and the patchiness of agricultural success in the Southwest created the necessity for areal intercommunity cooperation, which was symbolized in pottery and elsewhere. Upham (1982), in discussing a later part of Southwestern prehistory, takes various decorated wares to be symbolic of political alliances with considerable coercive power and tightly coordinated economic systems. Wilcox (1993) takes the direct approach, and says that not only were the producers peasants, they were subject to extraction of tribute by force.

"Rank societies" (Fried 1967) have a number of developmental attributes that are apropos to the Chaco system, including larger settlements, coordination of dispersed settlements, and the maintenance of trade with communities exploiting somewhat different resources. The likelihood that individuals will take the opportunity to enrich and aggrandize themselves is largely a philosophical, human nature question. Further, it is a practical question as to how much material wealth can be extracted under a given set of conditions. Upham (1982) and Sebastian (1992) assume that the opportunity will be seized. In less developed and, importantly, less densely populated situations (Lekson 1984c), however, there are often mechanisms that counteract individuals taking the opportunity. These mechanisms are very much in evidence among the historic pueblos. It may also be that the self-aggrandizement gene is not dominant in all groups.

It is often argued that even historic pueblo social structure is not egalitarian, implying that social differentiation was much greater prehistorically (e.g., Brandt 1980; Sebastian 1992; Upham 1982). Much of the differentiation is accorded to offices and societies and that the ideal is for holders of "status" positions not to accumulate wealth. Given the quantity and quality of evidence for differentiation, I feel that the environmental strictures are probably the most important cause for the levels of <u>costumbre</u>-related evidence from the Chaco system. There were probably social developments of a complexity somewhat greater than many historic pueblos, but certainly not on a central Mesoamerican scale (Lekson 1984a:272-273).

> If studies of specialization and of the development of more specialized systems of production are to be useful, they must seek to eliminate the possibility that simpler systems of production organization could have produced the patterning seen in the archeological record (Muller 1984: 484).

All the visible sanctions for <u>costumbre</u> seem to rest with the community and similar mechanisms may be observed in situations in which the population is more dispersed and less socially differentiated than Mesoamerica or the Anasazi. The ceramic evidence from Chaco Canyon, as analyzed here, does not clearly "eliminate the possibility" that simple systems of production account for the standardization apparent (Muller 1984:484). The areal scale of ceramic similarity is greater than any political system that could be realistically proposed, spanning as it does multiple archeological and physiographic regions.

The regional and subregional identifications possible have several conceivable social and economic functions: as symbols of various levels of group interactions, as products of part-time specialists, or as vessels of particular ceremonial or social significance. These functions require a substantial population with some differentiation in roles. Reduced variability in pots may well be manifestations of regions integrated by common belief systems and something akin to <u>costumbre</u>. Specialization is an aspect of complex societies, but the type of specialization which can be reasonably supported here does not require that control be vested in an elite for its existence.

<u>Pottery and Interaction in the Chaco World</u>

Pottery is perhaps the best single indicator of the extraordinarily active and complex relationships that existed in the prehistoric pueblo world. From the study of pottery we can begin to better comprehend the scale of several phenomena. In the ideological realm, the spread of shared designs is enormous, rivalling the distribution of greathouses (see Lekson 1991). The scale of goods movement within the San Juan Basin was beyond that in areas of comparable size and period.

There are suggestions that vessels may have been intentionally destroyed—or sacrificed. Some of the clearest evidence for this is in the Pueblo Alto Trash Mound, where groups of sherds from single vessels indicate that the vessel was broken into many small pieces and deposited all at once (Toll 1985:197-201; Toll and McKenna 1987:54, 178-181). Less direct evidence for such intentional destruction is the high frequency of grayware rim fillets in the trash mound (see Appendix 2A.10 Unidentified Corrugated), and the absence of restorable grayware jars from Pueblo Alto. Ethnographic accounts of ritual vessel breakage exist for several pueblos (Toll and McKenna 1987:178-182). Especially in view of the long distances much of the pottery at Chaco was transported, why would the people have broken vessels on purpose? Whether conscious or not, one effect of cyclical breakage of vessels would have been a creation of demand, which would keep important exchanges and relationships active (as Rappoport 1968:224-242), increasing participation in and commitment to the economic system.

A fundamental tenet of much Chaco archeological writing and thinking is that Chaco used the region—the region served the center. The rhetoric of regional analysis, however, can provide an additional perspective. We say that we cannot understand Chaco without studying the region. Most say that Chaco could not have existed without the region. Rather than dictating to and apportioning the region, it may be that the center grew and was sustained by communities around the region. As archeologists study the past, there is a continual tension between understanding the record locally and seeing local events in their regional context. This local-regional tension surely had a counterpart for the people whom we are studying: they were continually faced with assuring that their local, immediate needs were met and figuring out how to maintain their membership and standing in regional interaction. The ceramics demonstrate several important aspects of the system: participation was paramount, movement was massive, and change and adjustment were constant.

Figure 2.25. Chuska whiteware jar handle depicting hands (FS 7217) from Room 112, Layer 8. Handle was found in the collections in 1997 and photographed by Barbara Ness Gimbel.

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Appendix 2A

Ceramic Group Definitions

H. Wolcott Toll, Peter J. McKenna, and Thomas C. Windes

The Chaco Project divided ceramics into graywares, whitewares (mineral-on-white and carbon-on-white types), redwares, and brownwares. The following definitions are presented in a standard format with text, tables, and illustrations for each group described. Our classification system subsumes some types that are identified by temper, most importantly, the Chuska series. In the definitions, these subsumed types are called "synonyms" in the tables in this report, or "analogous types" (Goetze and Mills 1993:22-27). The percentage of the total temper group that falls into a subsumed type is given in the tables. "Similar types" are groups that share many attributes with the group as defined here, but differ in some attribute—such as paint type—which was used in this analysis as a grouping criterion. Sand or sandstone is the predominant temper in most of the types covered by these tables. Sandstone temper is broken down in terms of associated constituents, primarily by quantity of sherd temper. In cases where an igneous temper occurs with sand, relative quantities of both were recorded in a majority of cases (see Temper and Paste section). When there was more igneous than sand the line in the table reads "igneous with sandstone;" where sandstone was dominant the row label is "sandstone with igneous."

The production spans given here are based on a variety of sources. For abundant types in this collection, Windes and McKenna have refined spans based on dated contexts and ceramic associations. Dates are also taken from published sources including Breternitz (1966), Carlson (1970), Colton and Hargrave (1937), Goetze and Mills (1993), Oppelt (1988), and Windes (1977; 1984b). Some photos have been included here, but a paucity of whole specimens as well as photographic resources means that the range of variability in Chaco ceramics is barely scratched. Professional color photographs of many of the types discussed here are available in Dittert and Plog (1980), Peckham (1990), and Powell and Gumerman (1987:88-90).

The groups defined here are a combination of sorting groups and more tightly defined ceramic types. Data for all the groups used by the detailed analysis are presented in the following groups:

Graywares:
- Lino Gray
- Lino Fugitive Red
- Polished Tan Gray (Obelisk Gray)
- Wide Neckbanded
- Narrow Neckbanded
- Neck Corrugated
- Pueblo II (PII) Corrugated
- Pueblo II-Pueblo III (PII-PIII) Corrugated
- Pueblo III (PIII) Corrugated
- Unidentified Corrugated

Whitewares:
- Mineral-on-white types:
  - Unpolished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white
  - Polished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white
  - Early Red Mesa Black-on-white
  - Red Mesa Black-on-white
  - Puerco Black-on-white

- Escavada Black-on-white
- Gallup Black-on-white
- Puesga Black-on-white
- Chaco Black-on-white
- Exotic Mineral-on-white
- Pueblo II-III (PII-III) Mineral-on-white
- Unidentified Whitewares

Carbon-on-white types:

- Unpolished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white
- Polished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white
- Pueblo II-Pueblo III (PII-PIII) Carbon-on-white
- Chaco McElmo Black-on-white
- Mesa Verde Black-on-white
- Tusayan Whiteware
- Chuska Black-on-white
- Chuska Carbon-on-white
- Chuska Carbon-on-white with Red Mesa design

Redwares:

- Black-on-red
- Polychrome
- Plain Red

Brownwares:

- Polished Smudged
- Other (Exotic) Brownwares

GRAYWARES

Lino Gray and Lino Fugitive Red

References: Colton (1955); Roberts (1929)

Synonyms:

Chaco: Lino Gray
Chuska: Bennett Gray (1.2 percent)
Mesa Verde: Chapin Gray (0.7 percent)
Tusayan: Lino Gray

Production span: A.D. 450 to 900

Tables: 2A.1 and 2A.2

Description:

Lino Gray is characterized by plain grayware vessels, primarily in closed forms. Vessel surfaces are scraped and smoothed; if polish is present the items were placed in the Polished Tan Gray (Obelisk Gray) group (see below). Some distinctive portion of the rim, neck, or shoulder is generally required to classify a sherd as Lino Gray, since plain gray body sherds are not distinguishable from body sherds from neckbanded vessels. Lino Gray rims usually have no flare and are tapered in cross-section (see Colton 1955). Lino Gray vessels usually contain abundant coarse quartz temper. This analysis makes a further surface treatment subdivision of Lino by placing vessels showing fugitive red pigment into a separate group. Given the transitory nature of fugitive red, there is no doubt that some items included in the Lino Gray group at one time had fugitive red pigment on them. Microscopic examination of sherds sometimes reveals the presence of fugitive red pigment (often trapped in tiny fissures on the vessel's surface) in cases where it is no longer visible to the unaided eye. The presence of a number of cases with fugitive pigment in the Lino group shows that the separation was not entirely consistent in practice.

These early types (Lino Gray, Lino Fugitive Red, and Polished Tan Gray [Obelisk Gray]) exhibit several vessel forms that are unusual or absent in later types, the most notable being the neckless tecomate (or "seed jar"—see form discussion in Chapter 2). The attributes of the Lino Gray and Lino Fugitive Red groups indicate that there are some differences between the two. The Lino Fugitive Red group lacks the rare bowls in the Lino Gray group. There is some evidence for a tendency for ollas (large jars with tall narrow necks in Lino) to exhibit fugitive red wash. The few "Lino Gray" bowls are likely to be unpainted portions of decorated vessels (either Basketmaker III-Pueblo I unpolished mineral or carbon), since bowls of this time period have large unpainted areas. Perhaps the most important difference is the absence of tecomates in the Lino Fugitive Red group, suggesting that fugitive red was mostly applied to necked vessels. Rather than an interesting avoidance of putting pigmented vessels on the fire, the apparent absence of sooting on Lino Fugitive Red cases is an artifact of a poorly designed variable which requires recording either sooting or presence of fugitive red (in turn an artifact of the belief in the sacrosanctity of the 80 column form in early coding days). Nonetheless, it is likely that fugitive red was applied to vessels not intended for cooking (see Errickson 1988), including ollas, pitchers, and canteens, as well as "jars" not to be used on the fire.

Figure: 2A.1

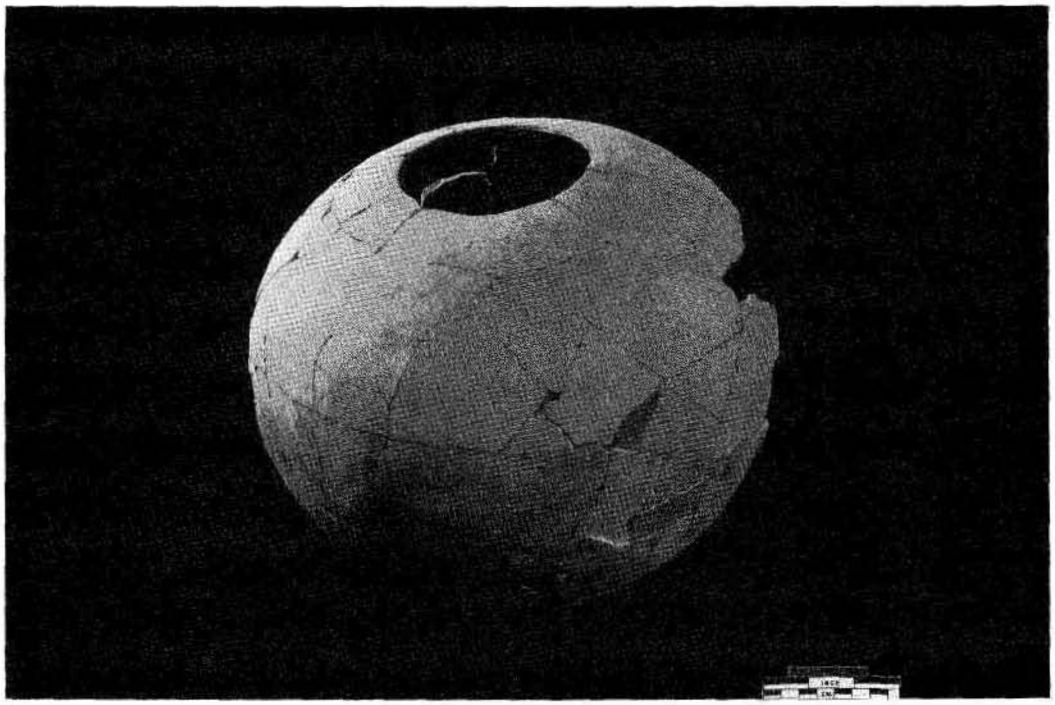


Figure 2A.1. Lino Gray tecomate from 29SJ 299. (NPS Chaco Archive Negative No. 13974).

Table 2A.1. Lino Gray definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	55	8.4	10.9
29SJ 299 PI	26	4.0	10.5
Pueblo Alto	-	-	-
29SJ 423	47	7.2	7.4
29SJ 627	136	20.8	1.8
29SJ 628	204	31.2	23.6
29SJ 629	33	5.1	1.9
29SJ 633	1	0.2	0.3
29SJ 721	14	2.1	9.8
29SJ 724	65	10.0	12.0
29SJ 1360	46	7.0	2.2
Shabik'eshchee	26	4.0	13.5
Total	653	100.0	3.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Unpolished plain	627	-	627	95.9
Polished plain	24	-	24	3.7
Undifferentiated banded	1	-	1	0.1
Wide neckbanded	1	-	1	0.1
Fingernail punctate	-	1	1	0.7
Total	653	1	654	99.9
No. with 1, 2 treatments	652	1	653	-
% with 1, 2 treatments	99.8	0.2	-	100.0

Type Design Diversity H' = 0.191
s = 5 J = 0.119

Table 2A.1. (continued)

2. Forms and Metrics

Forms	No.	%
Bowl	13	2.0
Jar	213	32.6
Olla	32	4.9
Seed jar	1	0.2
Tecomate	366	56.0
Canteen	4	0.6
Pitcher	9	1.4
Pipe	1	0.2
Unknown	14	2.1
Total	653	100.0

Metrics	No.	Range	$\bar{x}$	s.d.	cv%
Bowls					
Orifice diameter	5	95-240 mm	161.0	57.600	35.8
Jar					
Orifice diameter	143	25-230 mm	94.4	34.960	37.0
Rim fillet	2	1-15 mm	8.0		23.7
Rim flare	1	39°		9.900	
Olla					
Orifice diameter	29	15-130 mm	78.1	17.745	22.8
Seed jar					
Orifice diameter	1	100 mm	-	-	-
Tecomate					
Orifice diameter	257	25-210 mm	99.3	32.300	32.6
Canteen					
Orifice diameter	2	25-85 mm	55.0	42.426	77.1
Pitcher					
Orifice diameter	8	50-145 mm	85.0	33.274	39.1
Rim fillet	1	15 mm	-	-	-
Pipe					
Orifice diameter	1	15 mm	-	-	-
Unknown					
Orifice diameter	1	170 mm	-	-	-

Diversity of Forms H' = 1.026
S = 8 J = 0.493

3. Handles

Type	No.	%
Solid coil	1	5.6
Multi-coil	1	5.6
Strap	9	50.0
Tabular lug	1	5.6
Perforated nubbin	4	22.2
Effigy	1	5.6
Unknown	1	5.6
Total	18	100.2

Handles:items = 1:36

4. Surface Alteration

Sooting	No.	%
Sooted	145	22.2
Unsooted	477	73.2
Fugitive red	30	4.6
Total	652	100.0

Worked sherds = 3 (0.5%).

Table 2A.1. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	504	79.1
All chalcedonic sandstone*	6	0.9
Sandstone with rounded iron oxide	74	11.6
Magnetitic sandstone	39	6.1
Trachyte	6	0.9
Trachyte > sandstone	3	0.5
Sandstone > trachyte	1	0.2
San Juan igneous with hornblende	3	0.5
Gray andesite with sandstone	1	0.2
Total	637	100.0

*Pink variety specified: n = 3

Temper Diversity H' = 0.826
s = 9 J = 0.376

2. Texture Attributes

Grain Size	No.	%
Fine	-	-
Medium	26	4.1
Coarse	375	58.9
Very coarse	236	37.0
Total	637	100.0

Density	No.	%
1-2%	7	2.3
5%	96	31.8
10%	152	50.3
20%	45	14.9
30%	1	0.3
>40%	1	0.3
Total	302	99.9

Sherd Temper	No.	%
None	618	97.0
<half	16	2.5
>half	3	0.5
Total	637	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	-	-
Medium	17	4.9
Coarse	191	55.4
Very coarse	137	9.7
Total	345	100.0

Texture Index	No.	%
Very fine (0-2)	1	0.4
Fine (2.1-4)	2	0.9
Fine-medium (4.1-7)	8	3.5
Medium (7.1-10)	40	17.3
Medium-coarse	48	20.8
Coarse (13.1-16)	48	20.8
Very coarse (16.1+)	84	36.4
Total	231	100.1

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	158	51.5
Black with white sherd	1	0.3
Gray with black & white sherd	6	1.9
Chuska gray homogeneous	3	1.0
Tan to brown clay	94	30.6
Black clay	14	4.6
White clay	31	10.1
Total	307	100.0

Vitrification	No.	%
Absent	218	55.1
Present	178	44.9
Total	396	100.0

Paste Diversity H' = 1.217
s = 7 J = 0.626

Table 2A.2. Lino Fugitive Red definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	92	44.7	18.3
29SJ 299 PI	23	11.2	9.3
Pueblo Alto	-	-	-
29SJ 423	4	1.9	0.6
29SJ 627	6	2.9	0.1
29SJ 628	45	21.8	5.2
29SJ 629	3	1.5	0.2
29SJ 633	1	0.5	0.3
29SJ 721	8	3.9	5.6
29SJ 724	7	3.4	1.3
29SJ 1360	8	3.9	0.4
Shabik'eshchee	9	4.4	4.7
Total	206	100.0	1.0

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Unpolished plain	163	-	164	84.1
Polished plain	30	-	30	15.4
Hooks, flags	-	1	1	0.5
Total	193	1	195	100.0
No. with 1, 2 treatments	193	1	194	-
% with 1, 2 treatments	99.5	0.5	-	100.0

13 cases missing design code.

Type Design Diversity H' = 0.461
s = 3 J = 0.419

2. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	1	0.5	28	40-120	80.7	20.171	25.0
Jar	174	84.5	14	60-100	77.5	13.400	17.3
Olla	19	9.2	-	-	-	-	-
Tecomate	1	0.5	1	130	-	-	-
Canteen	1	0.5	1	30	-	-	-
Pitcher	5	2.4	5	70-120	94.0	19.494	20.7
Unknown	5	2.4	-	-	-	-	-
Total	206	99.9	-	-	-	-	-

Diversity of Forms H' = 0.519
s = 6 J = 0.290

Table 2A.2. (continued)

3. Handles

Type	No.	%
Solid coil	6	33.3
Strap	6	33.3
Strap lug	2	11.1
Perforated nubbin	2	11.1
Vertical fillets	2	11.1
Total	18	99.9

Handles:items = 1:11

4. Surface Alteration

Sooting	No.	%
Sooted (not observed)	-	-
Unsooted	1	0.5
Fugitive red	205	99.5
Total	206	100.0

Worked sherds = 5 (2.4%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	132	72.1
All chalcedonic sandstone*	-	-
Sandstone with rounded iron oxide	45	24.6
Magnetitic sandstone	4	2.2
San Juan igneous with hornblende	1	0.5
San Juan igneous without hornblende	1	0.5
Total	183	99.9

* No varieties specified

Temper Diversity H' = 0.758
s = 6 J = 0.423

2. Texture Attributes

Grain Size	No.	%
Fine	-	-
Medium	15	8.2
Coarse	82	44.8
Very coarse	86	47.0
Total	183	100.0

Density	No.	%
1-2%	1	0.8
5%	32	27.3
10%	65	55.6
20%	14	12.0
30%	5	4.3
Total	117	100.0

Sherd Temper	No.	%
None	183	100.0
Total	183	

Table 2A.2. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	-	-
Medium	10	10.5
Coarse	39	41.1
Very coarse	46	48.4
Total	95	100.0

Texture Index	No.	%
Very fine (0-2)	-	-
Fine (2.1-4)	-	-
Fine-medium (4.1-7)	1	0.9
Medium (7.1-10)	13	12.3
Medium-coarse (10.1-13	24	22.6
Coarse (13.1-16)	32	30.2
Very coarse (16.1+)	36	34.0
Total	106	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	33	28.2
Tan to brown clay	47	40.2
Black clay	1	0.8
White clay	36	30.8
Total	117	100.0

Vitrification	No.	%
Absent	72	58
Present	51	41.5
Total	123	99.5

Paste Diversity H' = 1.127
s = 4 J = 0.813

Polished Tan Gray (Obelisk Gray)

References: Morris (1980)

Synonyms:

Chaco: Lino Polished, Obelisk Gray
Chuska: Bennett Gray (0.5 percent)
Mesa Verde: Twin Trees Plain (0.7 percent)
Tusayan: Obelisk Gray

Production span: A.D. 450 to 750

Table: 2A.3

Description:

This group is likely to contain several categories of early undecorated pottery. A portion of it is probably a polished variant of Lino Gray, analogous to Twin Trees Plain and Chapin Gray (Breternitz et al. 1974:2). Another subgroup may also represent earlier vessels produced using clays different from those used in somewhat later Lino types. As indicated by the "tan" in the name, the group tends to have brownish paste, although surface color can be quite variable. Although it is possibile that some items included within it are very early, essentially Sambrito Brown, which is generally polished (Wilson 1989), and one of the first kinds of pottery produced in this part of the Southwest (LeBlanc 1982), any Sambrito in this collection was probably placed in the Exotic Brownware class.

Table 2A.3. Polished Tan Gray (Obelisk Gray) definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	150	27.9	29.8
29SJ 299 PI	5	0.9	2.0
Pueblo Alto	-	-	-
29SJ 423	244	45.4	38.3
29SJ 627	6	1.1	0.1
29SJ 628	7	1.3	0.8
29SJ 629	-	-	-
29SJ 633	-	-	-
29SJ 721	24	4.5	16.8
29SJ 724	-	-	-
29SJ 1360	-	-	-
Shabik'eshchee	102	19.0	52.8
Total	538	100.0	2.7

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Unpolished plain	7	-	7	1.3
Polished plain	530	-	529	98.3
Mummy Lake style	1	-	1	0.2
Punctate	-	1	1	0.2
Totals	538	1	538	100.0
No. with 1, 2, treatments	536	1	537	-
% with 1, 2, treatments	99.8	0.2	-	100.0

Type Design Diversity H' = 0.096
s = 4 J = 0.070

2. Polish

	Open		Closed			
Type	No.	%	No.	%	No.	%
None	1	6.2	11	2.2	12	2.4
Unknown	1	6.2	14	2.8	15	2.9
One side						
Streaky	1	6.2	48	9.7	49	9.6
Moderate	1	6.2	235	47.5	236	46.2
Completely polished	2	12.5	92	18.6	94	18.4
Both sides						
Streaky	1	6.2	20	4.0	21	4.1
Moderate	6	37.5	62	12.5	68	13.3
Completely polished	3	18.8	10	2.0	13	2.5
Differential interior/ exterior polish	-	-	3	-	3	0.6
Totals	16	99.8	495	99.9	511	100.0

* Less unknown forms n= 24.

Table 2A.3. (continued)

3. Forms and Metrics

Forms	No.	%
Bowl	16	3.0
Jar	433	80.9
Olla	3	0.6
Tecomate	55	10.3
Pipe	4	0.7
Unknown	27	4.5
Total	538	100.0

Metrics	No.	Range	$\bar{x}$	s.d.	cv %
Bowls					
Orifice diameter	2	100-200 mm	150.0	-	-
Jars					
Orifice diameter	12	45-130 mm	80.0	26.112	32.6
Rim fillet					
Orifice diameter	1	10 mm	-	-	-
Rim flare					
Orifice diameter	1	35°	-	-	-
Olla					
Orifice diameter	3	70-85 mm	76.7	7.638	10.0
Tecomate					
Orifice diameter	34	55-150 mm	88.4	21.802	24.7

Diversity of Forms H' = 0.557
s = 5 J = 0.346

4. Handles

Type	No.	%
Perforated nubbin	1	100.0

5. Surface Alteration

Sooting	No.	%
Sooted	26	4.9
Unsooted	470	87.3
Fugitive	42	7.8
Total	538	100.0

Worked sherds = 6 (1.1%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	350	79.9
All chalcedonic sandstone*	6	1.4
Sandstone with rounded iron oxide	60	13.7
Magnetitic sandstone	17	3.9
Trachyte	2	0.5
San Juan igneous with hornblende	2	0.5
San Juan igneous without hornblende	1	0.2
Total	438	100.1

* No varieties specified

Temper Diversity H' = 0.700
s = 7 J = 0.359

Table 2A.3. (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	7	1.6
Medium	48	11.0
Coarse	247	56.4
Very coarse	136	31.0
Total	438	100.0

Density	No.	%
1-2%	7	1.7
5%	109	26.7
10%	215	52.7
20%	69	16.9
30%	5	1.2
>40%	1	0.7
Total	408	99.9

Sherd Temper	No.	%
None	437	99.8
<half	1	0.2
Total	438	100.0

Undifferentiated sandstone Grain Size	No.	%
Fine	7	2.0
Medium	41	12.0
Coarse	187	54.7
Very coarse	107	31.3
Total	342	100.0

Texture Index	No.	%
Very fine (0-2)	-	-
Fine (2.1-4)	-	-
Fine-medium (4.1-7)	4	2.6
Medium (7.1-10)	27	17.5
Medium-coarse (10.1-13)	32	20.8
Coarse (13.1-16)	48	31.2
Very coarse (16.1+)	43	27.9
Total	154	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	166	40.7
Chuska gray homogeneous	1	0.2
Tan to brown clay	211	51.7
Black clay	19	4.7
White clay	11	2.7
Total	408	100.0

Vitrification	No.	%
Absent	116	28.5
Present	291	71.5
Total	407	100.0

Paste Diversity H' = 0.962
s = 5 J = 0.598

Wide Neckbanded

References: Colton and Hargrave (1937)

Synonyms:

Chaco: Kana'a Gray, Banded Neck Culinary
Chuska: Tocito Gray and Sheep Springs Gray (9.9 percent)
Mesa Verde: Moccasin Gray (1.1 percent)
Tusayan: Kana'a Gray

Production span: A. D. 850 to 925

Table: 2A.4

Description:

Wide Neckbanded is the earliest of the types in which coil construction above the shoulder of the pot are left exposed, rather than being smoothed over as in Lino Gray. Fillet width varies from vessel to vessel; although our coding makes a cutoff at 5 mm, fillets in this type are often considerably wider, exceeding 10 mm (see Goetze and Mills 1993:55). Treatment of the coils also varies from partial obliteration to being left clearly visible; some coils are quite regular in width, others less so. The treatments recorded distinguished between neckbanding and clapboarding in both Wide and Narrow Neckbanded. Neckbanding indicates that the fillets are visible but that there is little difference in relief between coils, while in clapboarding the upper coil overlaps and overhangs the top edge of the lower coil. In Wide Neckbanded, tooling on the lower edges (which is seen more often in Narrow Neckbanded) is usually lacking, and it is likely that clapboarding becomes more frequent toward the end of the production span. The body of the vessel below the shoulder is scraped and smoothed. The fillet at the rim of the vessel (a measured attribute) averages slightly wider than in Narrow Neckbanded, but rim fillets in the two types are statistically similar (Figure 2.20).

This type appears to have a very short production span, making it a good temporal marker. While it is commonly given a span of A.D. 800 to 950, its clear association with Early Red Mesa Black-on-white in single component sites (see Windes 1993:459-463) suggests the more restricted range given here. This type has the highest relative frequency of chalcedonic sandstone temper of any in this assemblage.

Figure: 2A.2

Figure 2A.2. Wide Neckbanded (Kana'a Neckbanded) jar from 29SJ 629, Pithouse 2. (NPS Chaco Archive Negative No. 15965C).

Table 2A.4. Wide Neckbanded definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	10	3.3	2.0
29SJ 299 PI	4	1.3	4.0
Pueblo Alto	17	5.7	2.0
29SJ 423	-	-	-
29SJ 627	159	53.2	2.1
29SJ 628	1	0.3	0.1
29SJ 629	28	9.4	1.6
29SJ 633	1	0.3	0.3
29SJ 721	2	0.7	1.4
29SJ 724	-	-	-
29SJ 1360	77	25.8	3.7
Shabik'eshchee	-	-	-
Total	299	100.0	1.5

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	22	-	22	7.1
Narrow neckbanding 2-5 mm	2	-	2	0.6
Wide neckbanding > 5 mm	72	-	72	23.4
Narrow clapboard 2-5 mm	1	-	1	0.3
Wide clapboard > 5 mm	200	-	200	64.9
Narrow corrugated 2-5 mm	1	-	1	0.3
Patterned, narrow 2-5 mm	1	-	1	0.3
Incised across coils	-	2	2	0.6
Incised between coils	-	1	1	0.3
Applique scrolls	-	1	1	0.3
Fingernail punctate	-	5	5	1.6
Totals	299	9	308	99.9
No. with 1, 2, treatments	290	9	299	-
% with 1, 2, treatments	97.0	3.0	-	100.0

Type Design Diversity H' = 1.046
s = 11 J = 0.436
Design Distribution Diversity H' = 0.132
s = 2 J = 0.436

2. Forms and Metrics

Form	No.	%
Jars	298	99.7
Pitcher	1	0.3
Total	299	100.0

Metrics	No.	Range	x̄	s.d.	cv %
Jars	-	-	-	-	-
Orifice diameter	209	13-350 mm	175.1	45.988	26.3
Rim fillet	243	9-29 mm	16.5	3.400	20.4
Rim flare	154	2-45°	18.1°	7.900	43.6
Pitcher					
Orifice diameter	1	140 mm	-	-	-
Rim fillet	1	19 mm	-	-	-

Forms Diversity H' = 0.022
s = 2 J = 0.032

Table 2A.4. (continued)

3. Handles

Type	No.	%
Solid coil	1	2.0
Multi-coil	4	7.8
Strap	2	3.9
Extended lip	2	3.9
Nubbin	29	56.9
Dual nubbins	3	5.9
Tabular lug	2	3.9
Cupule lug	4	7.8
Multi-coil strap	3	5.9
Unknown	1	2.0
Total	51	100.0

Handles:items = 1:6

4. Surface Alteration

Sooting	No.	%
Sooted	93	31.4
Unsooted	202	68.2
Fugitive red	1	0.3
Total	296	99.9

Worked sherds = 3 (1.0%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	193	68.0
All chalcedonic sandstone*	56	19.7
Sandstone with rounded iron oxide	1	0.4
Magnetitic sandstone	3	1.1
Trachyte	28	9.9
San Juan igneous with hornblende	1	0.4
San Juan igneous with hornblende + sandstone	1	0.4
San Juan igneous without hornblende	1	0.4
Total	284	100.3

Varieties specified: pink n = 45

Temper Diversity H' = 0.937
s = 8 J = 0.450

2. Texture Attributes

Grain Size	No.	%
Fine	1	0.4
Medium	40	14.1
Coarse	145	51.1
Very coarse	98	34.5
Total	284	100.1

Density	No.	%
1-2%	6	2.2
5%	36	12.9
10%	177	63.4
20%	54	19.3
30%	5	1.8
>40%	1	0.4
Total	279	100.0

Sherd Temper	No.	%
None	256	90.1
<half	19	6.7
>half	9	3.2
Total	284	100.0

Table 2A.4. (continued)

Undifferentiated Sandstone

Undifferentiated Sandstone Grain Size	No.	%
Fine	1	0.5
Medium	21	10.9
Coarse	95	49.5
Very coarse	75	39.1
Total	192	100.0

Texture Index	No.	%
Very fine (0-2)	1	0.3
Fine (2.1-4)	4	1.4
Fine-medium (4.1-7)	18	6.5
Medium (7.1-10)	37	13.3
Medium coarse (10.1-13)	34	12.2
Coarse (13.1-16)	92	33.3
Very coarse (16.1+)	93	33.3
Total	279	100.3

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	152	54.4
Black with white sherd	5	1.8
Gray with black sherd	3	1.1
Gray with white sherd	3	1.1
Chuska gray homogeneous	7	2.5
Tan to brown clay	42	15.1
Black clay	44	15.8
White clay	23	8.2
Total	279	100.0

Vitrification	No.	%
Absent	39	13.9
Present	242	86.1
Total	281	100.0

Paste Diversity H' = 1.375
s = 8 J = 0.661

Narrow Neckbanded

References: Toll and McKenna (1992)

Synonyms:

Chaco: Tohatchi Banded, Developmental Pueblo Neckbanded
Chuska: Gray Hills Banded, Captain Tom Corrugated (21.8 percent)
Mesa Verde: Mancos Gray (1.0 percent)
Tusayan: Kana'a Gray

Production span: A.D. 900 to 1050

Table: 2A.5

Description:

Narrow Neckbanded is the primary grayware type associated with Red Mesa Black-on-white. As with wide neckbanded and neck-corrugated, the globular to ovoid portion of the pot below the neck was smoothed. In many cases the neck coils are left exposed with little further alteration. The most frequent manipulation of the coils on the neck is clapboarding the exposed coils, often by tooling between coils. Tooling across coils or creation of patterns with the coils occur, but are much less common than simpler variations on neckbanding. Incision across coils occurs more often in Narrow Neckbanded than in other types; as in other types, it is seen in trachyte-tempered sherds disproportionately to the amount of trachyte temper (trachyte is 22 percent of the temper sample but 50 percent of the analyzed cases with incisions across coils are trachyte-tempered). Coil width and manipulation are critical to placement in this type, but within the parameters of neckbands narrow enough to be in this type there is variability in band width. While 91 percent of Wide Neckbanded cases have wide banding or clapboarding as their primary surface treatment, there are still 30 percent of Narrow Neckbanded cases with bands over 5 mm wide. These apparently contradictory cases of Narrow Neckbanded with wide neck bands are "Narrow" Neckbanded because of the more formal treatment of the bands than is common in Wide Neckbanded.

The single bowl in this sample is also the only member of the group that exhibits fugitive red wash. This unusual specimen is from 29SJ 423.

Table 2A.5. Narrow Neckbanded definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	10	1.5	2.0
29SJ 299 PI	10	1.5	4.0
Pueblo Alto	110	16.6	2.0
29SJ 423	1	0.2	0.2
29SJ 627	300	45.4	4.0
29SJ 628	4	0.6	0.5
29SJ 629	64	9.7	3.7
29SJ 633	8	1.2	2.5
29SJ 721	-	-	-
29SJ 724	1	0.2	0.2
29SJ 1360	153	23.1	7.3
Shabik'eshchee	-	-	-
Total	661	100.0	3.3

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	114	-	114	16.1
Narrow neckbanding 2-5 mm	70	-	70	9.9
Wide neckbanding >5 mm	32	-	32	4.5
Narrow clapboard 2-5 mm	235	-	235	33.2
Wide clapboard > 5 mm	163	2	165	23.3
Wide corrugated > 5 mm	1	-	1	0.1
Undifferentiated corrugated	1	1	2	0.3
Corrugated, festoon	1	2	3	0.4
Patterned, narrow 2-5 mm	24	-	24	3.4
Patterned, wide > 5 mm	12	-	12	1.7
Corrugated, unknown	2	-	2	0.3
Mummy Lake style	1	-	1	0.1
Incised across coils	1	17	18	2.6
Incised between coils	1	10	11	1.6
Punctate	-	5	5	0.7
Fingernail punctate	-	11	11	1.6
Applique scrolls	-	1	1	0.1
Totals	658	49	707	99.9
No. with 1, 2 treatments	609	49	658	-
% with 1, 2 treatments	92.6	7.4	-	100.0

Type Design Diversity H' = 1.895
s = 17 J = 0.669
Design Distribution Diversity H' = 0.244
s = 2 J = 0.353

Table 2A.5 (continued)

2. Forms and Metrics

Form	No.	%
Bowl	1	0.2
Jars	651	98.5
Pitcher	8	1.2
Miniature	1	0.2
Total	661	100.1

Metrics	No.	Range	x̄	s.d.	cv %
Jars					
Orifice diameter	505	50-350 mm	179.8	53.140	29.6
Rim fillet	571	6- 42 mm	15.6	4.030	25.9
Rim flare	308	4-42°	18.6	7.873	42.4
Pitcher	-	-	-	-	-
Orifice diameter	6	55-150 mm	108.3	33.417	30.9
Rim fillet	6	11-18 mm	14.8	2.317	15.61
Rim flare	4	9-45°	25.5	18.212	71.4
Miniatures					
Orifice diameter	1	60 mm			
Rim fillet	1	10 mm			

Forms Diversity H' = 0.088
s = 4 J = 0.064

3. Handles

Type	No.	%
Solid coil	3	4.1
Multi-coil	4	5.5
Strap	4	5.5
Extended lip	4	5.5
Nubbin	32	43.8
Dual nubbins	10	13.7
Strap lug	1	1.4
Tabular lug	7	9.6
Capule lug	4	5.5
Sagging nubbins	2	2.7
Unknown	2	2.7
Total	73	100.0

4. Surface Alteration

Sooting	No	%
Sooted	208	32.0
Unsooted	451	67.8
Fugitive red	1	0.2
Total	600	100.0

Handles:items = 1:9

Worked sherds = 0.

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	375	61.1
All chalcedonic sandstone*	87	14.2
Sandstone with rounded iron oxide	3	0.5
Magnetitic sandstone	8	1.3
Trachyte	122	19.9
Trachyte > sandstone	10	1.6
Sandstone > trachyte	2	0.3
San Juan igneous with hornblende	1	0.2
San Juan igneous without hornblende + sandstone	3	0.5
Sandstone + San Juan igneous without hornblende	2	0.3
Sandstone + unidentified igneous	1	0.2
Total	614	100.1

*Varieties specified: pink n = 55.

Temper Diversity H' = 1.133
s = 11 J = 0.472

Table 2A.5 (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	5	0.8
Medium	107	17.4
Coarse	310	50.5
Very coarse	192	31.3
Total	614	100.0

Density	No.	%
1-2%	4	0.7
5%	97	16.2
10%	368	61.3
20%	115	19.2
30%	15	2.5
>40%	1	0.2
Total	600	100.0

Sherd Temper	No.	%
None	567	92.3
<half	38	6.2
>half	9	1.5
Total	614	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	2	0.5
Medium	52	14.0
Coarse	180	48.4
Very coarse	138	37.1
Total	372	100.0

Texture Index	No.	%
Very fine (0-2)	-	-
Fine (2.1-4)	10	1.7
Fine-medium (4.1-7)	26	4.3
Medium (7.1-10)	101	16.9
Medium-coarse (10.1-13)	86	14.4
Coarse (13.1-16)	192	32.0
Very coarse (16.1+)	184	30.7
Total	599	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	299	49.8
Black with white sherd	13	2.2
Gray with black sherd	3	0.5
Gray with white sherd	7	1.2
Chuska gray homogeneous	71	11.8
Tan to brown clay	100	16.7
Black clay	64	10.7
White clay	43	7.2
Total	600	100.1

Vitrification	No.	%
Absent	103	16.9
Present	256	42.1
Marked	249	41.0
Total	606	100.0

Paste Diversity H' = 1.487
s = 8 J = 0.715

Neck Corrugated

References: Toll and McKenna (1993)

Synonyms:

Chaco: Exuberant Corrugated, Coolidge Corrugated
Chuska: Newcomb Corrugated (25.8 percent)
Mesa Verde: Mancos Gray and Mancos Corrugated in part (1.3 percent)
Tusayan: Medicine Gray

Production span: A.D. 975 to 1050

Table: 2A.6

Description:

Coeval in production with the latter part of the span for Narrow Neckbanded, Neck Corrugated vessels have plain gray bodies and indented corrugated necks. This is another type that will only be recognized if a portion of the neck is present, and will otherwise increase the "Plain Gray" counts. Windes (1977:302-305) points out that the mixture of surface treatments at this time period means that sherds from a single vessel could be placed into several different types. As implied by the name used for this type in the old Chaco series, Exuberant Corrugated, the corrugation on these vessels is often bold, large, and wavy. The occurrence of wider fillets and festooning (broad, draped-looking fillets: Toll and McKenna 1993:28, Plate 1.4g; Windes 1977:304, 342) in this type is far higher than in later types, although the rim fillet itself tends to be narrower than in later types (Figure 2.20). Neck Corrugated is another type with a short production span, making it a good temporal marker.

Archeologists have speculated that corrugation has a number of functional advantages including heat transfer (whether for heating during cooking or cooling during water storage) and increased texture to improve grip (Young and Stone 1990). Textured surfaces also appear to increase thermal shock resistance (Schiffer et al. 1994). Some clays are much more amenable to corrugation than others (C. D. Wilson, E. Blinman, personal communication 1996). Since corrugation was first used on vessel necks, it is likely that it began as a decorative device which was recognized as having functional benefits. The discontinuation of corrugation in post Chaco utility wares further suggests that its functional properties were secondary to its stylistic ones, although there is obviously a complex interaction of technological and social factors at play.

Figures: 2A.3 and 2A.4

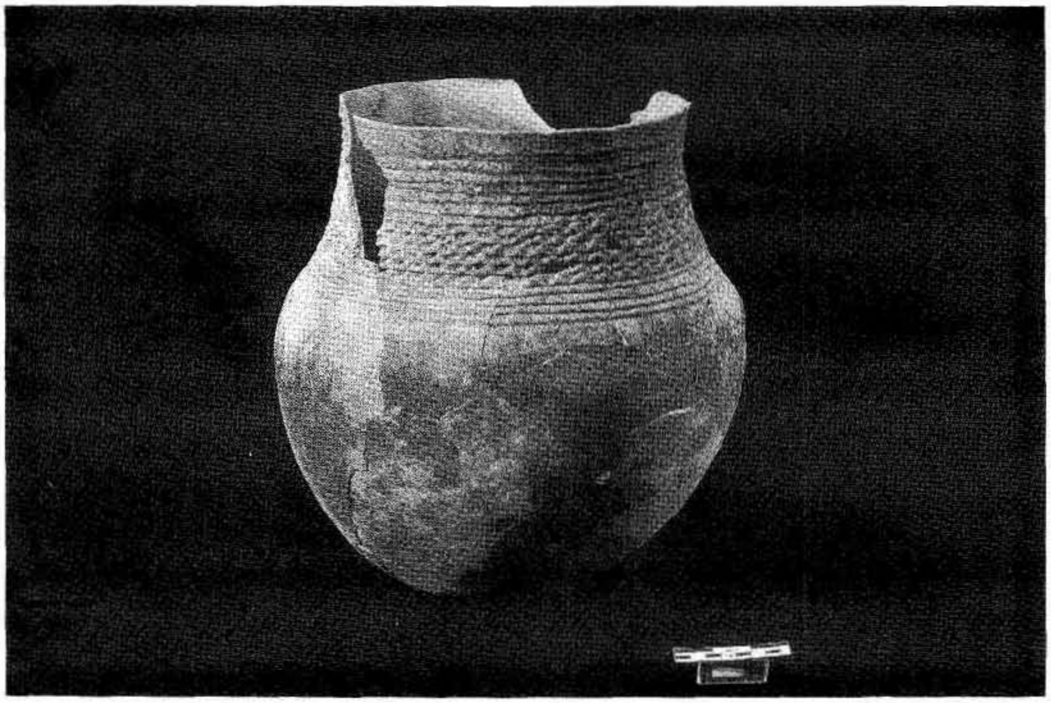


Figure 2A.3. Neck Corrugated jar from 29SJ 1360, House 1. (NPS Chaco Archive Negative No. 13965).

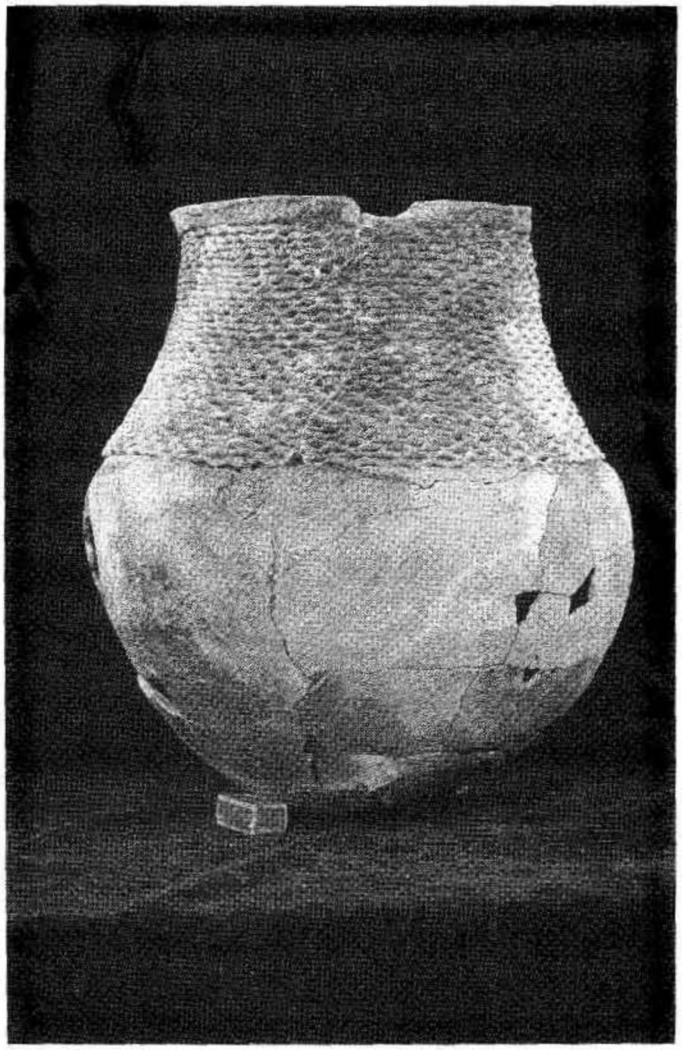


Figure 2A.4. Neck Corrugated (Tohatchi Corrugated) jar from 29SJ 629, Room 2. (NPS Chaco Archive Negative No. 15966A).

Table 2A.6. Neck Corrugated definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 629 BMIII	12	4.9	2.4
29SJ 299 PI	-	-	-
Pueblo Alto	24	9.7	0.4
29SJ 423	-	-	-
29SJ 627	113	45.7	1.5
29SJ 628	-	-	-
29SJ 629	45	18.2	2.6
29SJ 633	3	1.2	0.9
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	50	20.2	2.4
Shabik'eshchee	-	-	-
Total	247	100.0	1.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	4	-	4	1.3
Narrow neckbanding 2-5 mm	5	2	7	2.3
Wide neckbanding >5 mm	4	2	6	2.0
Narrow clapboard 2-5 mm	17	5	22	7.3
Wide clapboard >5 mm	9	2	11	3.6
Narrow corrugated	25	4	29	9.6
Wide corrugated >5 mm	70	8	78	25.8
Flattened corrugations	-	1	1	0.3
Undifferentiated corrugated	5	1	6	2.0
Corrugated, festoon	61	9	70	23.2
Corrugated oblique	4	4	8	2.6
Patterned, narrow 2-5 mm	23	-	23	7.6
Patterned, wide >5 mm	12	-	12	4.0
Corrugated, unknown	4	-	4	1.3
Punctate	-	5	5	1.7
Fingernail punctate	1	14	15	5.0
Exterior jar rim design	1	-	1	0.3
Totals	245	57	302	99.9
No. with 1,2 treatments	188	57	245	-
% with 1, 2 treatments	76.7	23.3	-	100.0

Type Design Diversity H' = 1.831
s = 18 J = 0.634

Table 2A.6. (continued)

2. Forms and Metrics

Form	No.	%
Jars	244	98.8
Pitcher	2	0.8
Olla	1	0.4
Total	247	100.0

Metrics	No.	Range	$\bar{x}$	s.d.	cv %
Jars					
Orifice diameter	175	6-350 mm	180.6	54.409	30.1
Rim fillet	194	6-27 mm	14.3	3.593	25.1
Rim flare	125	5-55°	20.2	8.740	43.3
Pitchers					
Orifice diameter	2	110-170 mm	140.0	42.426	30.3
Rim fillet	2	14-15 mm	14.5	0.707	4.9
Rim flare	1	9°	-	-	-
Olla					
Orifice diameter	1	90 mm	-	-	-

Forms Diversity H' = 0.073
s = 3 J = 0.067

Worked sherds = 2 (0.8%)

3. Handles

Type	No.	%
Strap	2	14.3
Nubbin lug	8	57.1
Strap lug	1	7.1
Tabular lug	1	7.1
Sagging nubbins	2	14.3
Total	14	99.9

Handles:items=1:18

4. Surface Alteration

Sooting	No.	%
Sooted	92	37.1
Unsooted	154	62.5
Fugitive red	1	0.4
Total	247	100.0

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	138	57.5
All chalcedonic sandstone*	29	12.1
Sandstone with rounded iron oxide	1	0.4
Magnetitic sandstone	8	3.3
Trachyte	57	23.8
Trachyte > sandstone	4	1.7
Sandstone > trachyte	1	0.4
San Juan igneous with hornblende + sandstone	1	0.4
San Juan igneous without hornblende + sandstone	1	0.4
Total	240	100.0

*Varieties specified: pink n = 11; white n = 18

Temper Diversity H' = 1.188
s = 9 J = 0.541

Table 2A.6. (continued)

2. Text Attributes

Grain Size	No.	%
Fine	3	1.3
Medium	37	15.4
Coarse	107	44.6
Very coarse	93	38.7
Total	240	100.0

Density	No.	%
1-2%	-	-
5%	37	15.6
10%	151	63.4
20%	45	18.9
30%	4	1.7
>40%	1	0.4
Total	238	100.0

Sherd Temper	No.	%
None	221	92.1
<half	10	4.2
>half	7	2.9
All	2	0.8
Total	240	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	-	-
Medium	21	15.2
Coarse	58	42.0
Very coarse	59	42.8
Total	138	100.0

Texture Index	No.	%
Very fine (0-2)	2	0.8
Fine (2.1-4)	4	1.7
Fine-medium (4.1-7)	9	3.8
Medium (7.1-10)	32	13.4
Medium-coarse (10.1-13)	36	15.1
Coarse (13.1-16)	68	28.6
Very coarse (16.1+)	87	36.6
Total	238	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	104	43.7
Black with white sherd	5	2.1
Gray with black sherd	1	0.4
Gray with black & white sherd	3	1.3
Chuska gray homogeneous	33	13.9
Gray with white sherd	4	1.7
Tan to brown clay	47	19.7
Black clay	18	7.6
White clay	23	9.7
Total	238	100.1

Vitrification	No.	%
Absent	52	21.7
Present	188	78.3
Total	240	100.0

Paste Diversity H' = 1.605
s = 9 J = 0.731

Pueblo II (PII) Corrugated

References: Goetze and Mills (1993:52-56); Windes (1977:305)

Synonyms:

Chaco: Chaco Corrugated, Coolidge Corrugated (in part)
Chuska: Blue Shale Corrugated (43.1 percent)
Mesa Verde: Mancos Corrugated (1.3 percent)
Tusayan: Tusayan Corrugated

Production span: A.D. 1040 to 1100

Table: 2A.7

Description:

Overall corrugation and a low degree of rim flare define this group. The rim, marked by a flattened, uncorrugated fillet, continues the trajectory of the neck with little or no flare. This means that a rim and enough of the body to see the degree of rim eversion must be present to distinguish this type from the two succeeding types. Although there is some overlap in rim eversion among items placed in these three types, there is a steady increase in the rim flare angle through them (see Figure 2.21). These changes in rim flare are consistent across much of the Anasazi area (see Cattanach 1980:213-227). Rim fillet widths cover a wide range but two-thirds are between 15 mm and 28 mm wide (Figure 2.20).

Of the identified grayware types, Pueblo II Corrugated is by far the most abundant in the Chaco Project collections and has the largest number of different surface treatments. Textures and modifications of corrugation are quite similar among the three overall corrugated types, most of which reported here were produced between A.D. 1040 and 1140: 4 to 5 percent of each type has oblique ridges formed by corrugations, and 3 to 4 percent have flattened corrugations. Additional markings such as incisions across coils or punctation occurs as one percent or less in all types. Both the number of surface treatments and their distribution show decrease through time, although sample sizes must contribute to that trend.

Figure: 2A.5

Figure 2A.5. *Pueblo II Corrugated vessel from 29SJ 629, Pithouse 2, showing the straight profile of the rim fillet relative to the body. This vessel is trachyte-tempered. (NPS Chaco Archive Negative No. 16012).*

Table 2A.7. Pueblo II (PII) Corrugated definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	2	0.2	0.4
29SJ 299 PI	2	0.2	0.8
Pueblo Alto	392	38.1	7.3
29SJ 423	-	-	-
29SJ 627	556	54.0	7.4
29SJ 628	1	0.1	0.1
29SJ 629	21	2.0	1.2
29SJ 633	10	1.0	3.1
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	46	4.5	2.2
Shabik'eshchee	-	-	-
Total	1,030	100.0	5.1

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	19	-	19	1.7
Narrow neckbanding 2-5 mm	4	3	7	0.6
Wide neckbanding > 5 mm	1	-	1	0.1
Narrow clapboard 2-5 mm	46	4	50	4.4
Wide clapboard > 5 mm	6	1	7	0.6
Narrow corrugated 2-5 mm	648	4	652	57.3
Wide corrugated > 5 mm	108	3	111	9.8
Flattened corrugations	1	43	44	3.9
Undifferentiated corrugated	71	-	71	6.2
Corrugated, festoon	7	-	7	0.6
Corrugated, oblique	10	35	45	4.0
Patterned, narrow 2-5 mm	86	-	86	7.6
Patterned, wide > 5 mm	6	-	6	0.5
Corrugated, unknown	4	-	4	0.3
Mummy Lake style	3	-	3	0.3
Incised across coils	2	9	11	1.0
Incised between coils	-	1	1	0.1
Punctate	-	3	3	0.3
Fingernail punctate	1	7	8	0.7
Totals	1,023	113	1,136	100.1
No. with 1, 2, treatments	910	113	1,023	-
% with 1, 2, treatments	89.0	11.0	-	100.0

Type Design Diversity H' = 1.645
s = 20 J = 0.549

Table 2A.7. (continued)

2. Forms and Metrics

Form	No.	%
Jars	1,022	99.2
Pitcher	6	0.6
Miniature	2	0.2
Total	1,030	100.0

Metrics	No.	Range	x̄	s.d.	cv %
Jars	-	-	-	-	-
Orifice diameter	875	70-350 mm	211.4	55.386	26.1
Rim fillet	1,005	8-53 mm	21.8	6.200	28.5
Rim flare	614	5-49°	25.5	7.565	29.6
Pitcher					
Orifice diameter	5	80-120 mm	100.0	20.000	20.0
Rim fillet	6	10-28 mm	14.8	6.735	45.4
Rim flare	2	18-28°	23.0	7.071	30.7
Miniatures					
Orifice diamater	2	35-60 mm	47.5	17.678	37.2
Rim fillet	-	-	-	-	-
Rim flare	1	15°	-	-	-

Forms Diversity H' = 0.050
s = 3 J = 0.045

3. Handles

Type	No.	%
Solid coil	3	7.3
Multi-coil	1	2.4
Strap	6	14.6
Nubbin	15	36.6
Dual nubbins	4	9.8
Strap lug	3	7.3
Tabular lug	6	14.6
Sagging nubbins	3	7.3
Total	41	99.9

Handles:items = 1:23

Worked sherds = 4 (0.4%)

4. Surface Alteration

Sooting	No.	%
Sooted	541	52.6
Unsooted	489	47.4
Total	1,030	100.0

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	413	47.6
All chalcedonic sandstone*	52	6.0
Sandstone with rounded iron oxide	3	0.3
Magnetitic sandstone	13	1.5
Trachyte	340	39.2
Trachyte > sandstone	30	3.5
Sandstone > trachyte	4	0.5
San Juan igneous with hornblende	3	0.3
San Juan igneous with hornblende + sandstone	1	0.1
San Juan igneous without hornblende	3	0.3
San Juan igneous without hornblende + sandstone	3	0.3
Sandstone + San Juan igneous without hornblende	1	0.1
Unidentified igneous + sandstone	1	0.1
Total	867	99.8

*Varieties specified: pink n = 39; white n = 13.

Temper Diversity H' = 1.195
s = 13 J = 0.466

Table 2A.7. (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	21	2.4
Medium	147	17.0
Coarse	392	45.2
Very coarse	307	34.5
Total	867	99.1

Density	No.	%
1-2%	31	3.6
5%	177	20.5
10%	446	51.7
20%	175	20.3
30%	30	3.5
>40%	4	0.5
Total	863	100.1

Sherd Temper	No.	%
None	760	87.7
<half	47	5.4
>half	51	5.9
All	9	1.0
Total	867	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	13	3.2
Medium	46	11.2
Coarse	163	39.6
Very coarse	189	46.0
Total	411	100.0

Texture Index	No.	%
Very fine (0-2)	20	2.3
Fine (2.1-4)	34	3.9
Fine-medium (4.1-7)	64	7.4
Medium (7.1-10)	120	13.9
Medium-coarse (10.1-13)	143	16.6
Coarse (13.1-16)	199	23.1
Very coarse (16.1+)	283	32.8
Total	863	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	361	41.8
Black with white sherd	14	1.6
Gray with black sherd	11	1.3
Gray with black & white sherd	3	0.4
Gray with white sherd	21	2.4
Chuska gray homogeneous	200	23.2
Tan to brown clay	135	15.6
Black clay	83	9.6
White clay	35	4.1
Total	863	100.0

Vitrification	No.	%
Absent	144	16.7
Present	350	40.5
Marked	369	42.8
Total	863	100.0

Paste Diversity H' = 1.581
s = 9 J = 0.720

Pueblo II-Pueblo III (PII-PIII) Corrugated

References: Toll and McKenna (1987)

Synonyms:

Chaco: Chaco Corrugated
Chuska: Hunter Corrugated in part (52.2 percent)
Mesa Verde: Dolores Corrugated (1.3 percent)
Tusayan: Tusayan Corrugated, Moenkopi Corrugated

Production span: A.D. 1075 to 1150

Table: 2A.8

Description:

Rims in this type are clearly everted but not to the degree of the latest (Pueblo III) type (see Peckham 1990:49-52 for a nice variety of rim eversions). As with Pueblo II and Pueblo III Corrugated, this rim eversion is observable only in sherds including the rim and adjacent neck. Metric attributes of this type are quite similar to Pueblo II Corrugated, and, indeed, both types make up "Chaco Corrugated" in earlier classifications. Trachyte temper forms a higher percentage in this type than any other in the Chaco series.

Table 2A.8. Pueblo II-Pueblo III (PII-PIII) Corrugated definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	-	-	-
Pueblo Alto	115	50.4	2.1
29SJ 423	-	-	-
29SJ 627	99	43.4	1.3
29SJ 628	-	-	-
29SJ 629	6	2.6	0.4
29SJ 633	8	3.5	2.5
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	-	-	-
Shabik'eshchee	-	-	-
Total	228	100.0	1.1

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Narrow neckbanding 2-5 mm	2	-	2	0.8
Narrow clapboard 2-5 mm	13	1	14	5.6
Narrow corrugated 2-5 mm	147	-	147	58.3
Wide corrugated > 5 mm	17	2	19	7.5
Flattened corrugations	1	7	8	3.2
Undifferentiated corrugated	21	-	21	8.3
Corrugated, oblique	4	8	12	4.8
Patterned, narrow 2-5 mm	17	-	17	6.7
Patterned, wide > 5 mm	2	-	2	0.8
Corrugated, unknown	1	-	1	0.4
Mummy Lake style	3	-	3	1.2
Incised across coils	-	2	2	0.8
Applique scrolls	-	1	1	0.4
Fingernail punctate	-	2	2	0.8
Painted motif on rim interior	-	1	1	0.4
Totals	228	24	252	100.0
No. with 1, 2 treatments	204	24	228	-
% with 1, 2 treatments	89.5	10.5	-	100.0

Type Design Diversity H' = 1.585
s = 15 J = 0.585
Design Distribution Diversity H' = 0.314
s = 2 J = 0.454

Table 2A.8. (continued)

2. Forms and Metrics

Form	No.	%
Jars	225	98.7
Olla	1	0.9
Miniature	2	0.4
Total	228	100.0

Metrics	No.	Range	$\bar{x}$	s.d.	cv %
Jars					
Orifice diamater	211	70-350 mm	213.2	54.627	25.6
Rim fillet	222	8-50 mm	22.4	6.759	30.2
Rim flare	159	15- 57°	34.1	6.743	19.7
Olla					
Orifice diameter	1	9 mm	-	-	-
Rim fillet	1	17 mm	-	-	-
Rim flare	1	32°	-	-	-
Miniatures					
Orifice diameter	2	60-80 mm	70.0	14.142	20.2
Rim fillet	2	10-11 mm	10.5	0.707	6.7
Rim flare	2	50-52°	51.0	1.414	2.8

Forms Diversity H' = 0.078
s = 3 J = 0.071

3. Handles

Type	No.	%
Nubbin	5	100

Handles:items = 1:46

Worked sherds = 0.

4. Surface Alteration

Sooting	No.	%
Sooted	140	61.4
Unsooted	88	38.6
Total	228	100.0

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	92	44.0
All chalcedonic sandstone*	4	1.9
Magnetitic sandstone	2	1.0
Trachyte	94	45.0
Trachyte > sandstone	12	5.7
Sandstone > trachyte	3	1.4
San Juan igneous with hornblende	1	0.5
San Juan igneous with hornblende + sandstone	1	0.5
Total	209	100.9

*Varieties specified: pink n = 9

Temper Diversity H' = 1.117
s = 8 J = 0.537

2. Texture Attributes

Grain Size	No.	%
Fine	5	2.4
Medium	50	23.8
Coarse	89	42.4
Very coarse	66	31.4
Total	210	100.0

Density	No.	%
1-2%	2	1.0
5%	49	24.0
10%	91	44.6
20%	50	24.5
30%	12	5.9
Total	204	100.0

Sherd Temper	No.	%
None	181	86.2
<half	19	9.0
>half	9	4.3
All	1	0.5
Total	210	100.0

Table 2A.8. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	2	2.2
Medium	14	15.2
Coarse	31	33.7
Very coarse	45	48.9
Total	92	100.0

Texture Index	No.	%
Very fine (0-2)	2	1.0
Fine (2.1-4)	9	4.3
Fine-medium (4.1-7)	16	7.6
Medium (7.1-10)	32	15.2
Medium-coarse (10.1-13)	50	23.8
Coarse (13.1-16)	42	20.0
Very coarse (16.1+)	59	28.1
Total	210	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	101	49.5
Black with white sherd	1	0.5
Gray with white sherd	4	2.0
Chuska gray homogeneous	41	20.1
Tan to brown clay	35	17.2
Black clay	13	6.4
White clay	9	4.4
Total	204	100.1

Vitrification	No.	%
Absent	25	12.3
Present	100	49.0
Marked	79	38.7
Total	204	100.0

Paste Diversity H' = 1.388
s = 7 J = 0.713

Pueblo III (PIII) Corrugated

References: Breternitz et al. (1974); McGarry (1975); Windes (1977:307-309)

Synonyms:

Chaco: Chaco Corrugated, Cibola Corrugated
Chuska: Hunter Corrugated in part (32.3 percent)
Mesa Verde: Mesa Verde Corrugated (5.2 percent)
Tusayan: Moenkopi, Tusayan Corrugated

Production span: A.D. 1100 to 1300

Table: 2A.9

Description:

The latest corrugated vessels continue the trend of increasing rim flare (Figure 2.21), with rim fillets on extreme examples rather severely bent back (see Rohn 1971:130-140). Examples of this group are relatively rare in the Chaco Project sample, as are other very late types. The type is more common on sites with Mesa Verde Black-on-white; a portion of 29SJ 633 is the only such site in this assemblage. As is true of Pueblo II and Pueblo II-III Corrugated, sherds from vessels of this group can only be identified from pieces of the rim and adjacent neck. While rim eversion is the critical variable for inclusion in this group, later corrugated vessels tend to be squatter and more rounded than earlier ones. Average rim fillet width is somewhat narrower than the preceding corrugated types, but the range of fillet widths is similar (Figure 2.20).

Trachyte temper is less common in these late sherds than in Pueblo II-III and Pueblo II Corrugated. The presence of sherd temper increases through the preceding types, reaching a high of over 20 percent in Pueblo III Corrugated.

Although the occurrence of wide body fillets decreases from Neck Corrugated through Pueblo II-III Corrugated, wider fillets are somewhat more common in this smaller sample. Conversely, there is also a higher frequency of the narrowest bands. The narrow and wide coil groups are approximately proportionally split between sand tempers and trachyte, indicating that these differences are not based purely on production area. The narrow coil group does contain a larger quantity of sherd temper, suggesting that Windes' impression (personal communication 1996) that the narrow coil group tends to be late has merit. McGarry's (1975) definition of Cibola Corrugated, based on ceramics from post A.D. 1300 sites in the Zuni area, includes extreme rim eversion and sherd temper; sherds conforming to this definition occur in Chaco but are rare.

Table 2A.9. Pueblo III (PIII) Corrugated definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	1	1.0	0.2
29SJ 299 PI	1	1.0	0.4
Pueblo Alto	46	44.2	0.9
29SJ 423	-	-	-
29SJ 627	47	45.2	0.6
29SJ 628	-	-	-
29SJ 629	2	1.9	0.1
29SJ 633	7	6.7	2.2
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	-	-	-
Shabik'eshchee	-	-	-
Total	104	100.0	0.5

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	2	-	2	1.7
Narrow neckbanding 2-5 mm	1	-	1	0.8
Wide neckbanding > 5 mm	-	1	1	0.8
Narrow clapboard 2-5 mm	1	-	1	0.8
Narrow corrugated 2-5 mm	72	1	73	61.9
Wide corrugated > 5 mm	12	1	13	11.0
Flattened corrugations	-	4	4	3.4
Undifferentiated corrugated	9	-	9	7.6
Corrugated, oblique	1	5	6	5.1
Patterned, narrow 2-5 mm	3	-	3	2.5
Corrugated, unknown	1	-	1	0.8
Mummy Lake style	2	-	2	1.7
Incised across coils	-	1	1	0.8
Fingernail punctate	-	1	1	0.8
Total	104	14	118	99.7
No. with 1, 2 treatments	90	14	104	-
% with 1, 2 treatments	86.5	13.5	-	100.0

Type Design Diversity H' = 1.447
s = 14 J = 0.560
Design Distribution Diversity H' = 0.364
s = 2 J = 0.525

Table 2A.9. (continued)

2. Forms and Metrics

Form	No.	%
Jars	103	99.0
Pitcher	1	1.0
Total	104	100.0

Metrics	No.	Range	x̄	s.d.	cv %
Jars					
Orifice diameter	96	70-330 mm	166.7	55.940	33.6
Rim fillet	102	6-37 mm	19.7	6.423	32.6
Rim flare	81	25-65°	43.0	7.749	18.0
Pitcher					
Orifice diameter	1	90 mm	-	-	-
Rim flare	1	40°	-	-	-

Forms Diversity H' = 0.054
s = 2 J = 0.078

3. Handles

Type	No.	%
Strap	1	12.5
Nubbin	5	62.5
Strap lug	1	12.5
Sagging nubbins	1	12.5
Total	8	100.0

Handles:items = 1:13

4. Surface Alteration

Sooting	No.	%
Sooted	58	55.8
Unsooted	46	44.2
Total	104	100.0

Worked sherds = 0.

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Sherd > sandstone	1	1.0
Undifferentiated sandstone	54	56.3
All chalcedonic sandstone*	4	4.2
Magnetitic sandstone	1	1.0
Trachyte	23	24.0
Trachyte > sandstone	7	7.3
Sandstone > trachyte	1	1.0
San Juan igneous with hornblende	2	2.1
San Juan igneous without hornblende	1	1.0
Sandstone + San Juan igneous without hornblende	1	1.0
Andesite with sandstone	1	1.0
Total	96	99.9

*Varieties specified: pink n = 4.

Temper Diversity H' = 1.355
s = 11 J = 0.565

Table 2A.9. (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	2	2.1
Medium	23	24.0
Coarse	35	36.4
Very coarse	36	37.5
Total	96	100.0

Density	No.	%
1-2%	2	2.1
5%	26	27.4
10%	49	51.6
20%	14	14.7
30%	3	3.2
>40%	1	1.0
Total	95	100.0

Sherd Temper	No.	%
None	75	78.1
<half	11	11.5
>half	8	8.3
All	2	2.1
Total	96	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	1	1.9
Medium	7	13.2
Coarse	17	32.1
Very coarse	28	52.0
Total	53	99.2

Texture Index	No.	%
Very fine (0-2)	3	3.2
Fine (2.1-4)	7	7.4
Fine-medium (4.1-7)	8	8.4
Medium (7.1-10)	14	14.7
Medium-coarse (10.1-13)	23	24.2
Coarse (13.1-16)	23	24.2
Very coarse (16.1+)	17	17.9
Total	95	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	46	48.4
Black with white sherd	2	2.1
Gray with black sherd	1	1.1
Gray with black & white sherd	1	1.1
Gray with white sherd	5	5.3
Chuska gray homogeneous	11	11.6
Tan to brown clay	12	12.6
Black clay	16	16.8
White clay	1	1.1
Total	95	100.1

Vitrification	No.	%
Absent	9	9.4
Present	41	42.7
Marked	46	47.9
Total	96	100.0

Paste Diversity $H' = 1.542$

$s = 9$ $J = 0.702$

Unidentified Corrugated

Included Types: All grayware series.

This is usually the largest group of pottery in any substantial Pueblo II or Pueblo III site collection in any portion of the Anasazi area (it is 30.7 percent of the total collections of the post Pueblo I sites discussed here—Table 2.1), and it is usually called something like unidentified or unclassified indented corrugated.

Production span: A.D. 975 to 1300

Table: 2A.10

Description:

Sherds in this group are usually completely corrugated on the exterior below the rim fillet and lack enough of the neck profile to judge the rim eversion. Since the detailed analysis here is based on rim sherds, and rim morphology is the primary criterion for identifying corrugated gray types, this group is much smaller than its bulk sample numbers would suggest it should be. Many of the items in this group that are in the detailed analysis are rim fillet sherds for which it was not possible to observe the rim flare and place them into "type" groups. Sherds in this group come from vessels that would have been placed in Neck Corrugated, Pueblo II, Pueblo II-III, and Pueblo III Corrugated if the whole vessel were present or if the rim flare could be observed. Since over 80 percent of the group comes from Pueblo Alto, and over half of it comes from the trash mound, most items in this group are either Pueblo II or Pueblo II-III Corrugated. The temper distribution within this group is in between those of Pueblo II and Pueblo II-III, supporting the likelihood that these sherds are from those groups. "Mummy Lake style" is very infrequent in all other grayware types here, but constitutes 24 percent of this group; again, nearly all occurrence of this design code are in the Pueblo Alto collection. The heavy use of this code again results from the large number of grayware rim fillets in the Pueblo Alto collection. Mummy Lake Gray is distinctive (Breternitz et al. 1974:13-14) and the occurrence of the design code does not indicate 368 Mummy Lake vessels at Pueblo Alto.

Table 2A.10. Unidentified Corrugated definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	5	0.3	1.0
29SJ 299 PI	13	0.9	5.3
Pueblo Alto	1,184	81.9	22.0
20SJ 627	158	10.9	2.1
29SJ 628	2	0.1	0.2
29SJ 629	35	2.4	2.1
29SJ 633	40	2.8	12.6
29SJ 721	1	0.1	0.7
29SJ 1360	8	0.6	0.4
Total	1,446	100.0	7.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Undifferentiated neckbanding	55	1	56	3.7
Narrow neckbanding 2-5 mm	4	-	4	0.3
Narrow clapboard 2-5 mm	18	3	24	1.4
Wide clapboard > 5 mm	2	-	2	0.1
Narrow corrugated 2-5 mm	422	1	423	27.7
Wide corrugated > 5 mm	77	2	79	5.2
Flattened corrugations	2	20	22	1.4
Undifferentiated corrugated	342	2	344	22.5
Corrugated, festoon	6	-	6	0.4
Corrugated, oblique	4	43	47	3.1
Patterned, narrow 2-5 mm	68	-	68	4.5
Patterned, wide > 5 mm	16	-	16	1.0
Corrugated, unknown 49	49	-	49	3.2
Mummy Lake style	371	1	372	24.3
Incised across coils	1	10	11	0.7
Punctate	-	4	4	0.3
Fingernail punctate	-	4	4	0.3
Totals	1,437	91	1,528	100.1
No. with 1, 2 treatments	1,346	91	1,437	-
% with 1, 2 treatments	93.7	6.3	-	100.0

Type Design Diversity H' = 1.946
s = 17 J = 0.687
Design Distribution Diversity H' = 0.217
s = 2 J= 0.313

2. Forms and Metrics

Form	No.	%
Jars	1,445	99.2
Pitcher	1	0.6
Total	1,446	100.0

Metrics	No.	Range	x̄	s.d.	cv %
Jars					
Orifice diameter	480	70-350 mm	213.8	58.670	27.4
Rim fillet	839	8-53 mm	22.1	6.276	28.4
Rim flare	25	25-40°	28.0	8.023	28.6

Forms Diversity H' = 0.006
s = 2 J = 0.008

Table 2A.10. (continued)

3. Handles

Type	No.	%
Multi-coil	5	5.9
Strap	5	5.9
Tubular	1	1.2
Nubbin	49	57.6
Dual nubbins	5	5.9
Strap lug	5	5.9
Tabular lug	7	8.2
Sagging nubbins	8	9.4
Total	85	100.0

Handles:items = 1:17

Worked sherds = 8 (0.6%).

4. Surface Alteration

Type	No.	%
Sooted	644	44.5
Unsooted	799	55.3
Fugitive red	1	0.1
Mineral crust	2	0.1
Total	1,446	100.0

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone	451	41.3
All chalcedonic sandstone*	81	7.4
Sandstone with rounded iron oxide	2	0.2
Magnetitic sandstone	21	1.9
Trachyte	457	41.8
Trachyte >sandstone	65	5.9
San Juan igneous with hornblende	4	0.4
San Juan igneous without hornblende	4	0.4
San Juan igneous without hornblende + sandstone	3	0.3
Unidentified igneous	2	0.3
Unidentiied igneous + sandstone	2	0.3
Total	1,092	100.1

*Varieties specified: pink n = 52; white n = 29

Temper Diversity H' = 1.259
s = 11 J = 0.525

2. Texture Attributes

Grain Size	No.	%
Fine	22	2.0
Medium	204	18.7
Coarse	540	49.5
Very coarse	326	29.8
Total	1,092	100.0

Density	No.	%
1-2%	50	4.8
5%	243	23.1
10%	526	50.0
20%	198	18.8
30%	32	3.1
40%	2	0.2
Total	1,051	100.0

Sherd Temper	No.	%
None	980	89.7
<half	63	5.8
>half	34	3.1
All	15	1.4
Total	1,092	100.0

Table 2A.10. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	9	2.0
Medium	42	9.3
Coarse	226	50.4
Very coarse	172	38.2
Total	450	99.9

Texture Index	No.	%
Very fine (0-2)	7	0.7
Fine (2.1-4)	40	3.8
Fine-medium (4.1-7)	101	9.6
Medium (7.1-10)	169	16.1
Medium-coarse (10.1-13)	208	19.8
Coarse (13.1-16)	290	27.6
Very coarse (16.1+)	236	22.4
Total	1,051	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	537	51.0
Black with white sherd	17	1.6
Gray with black sherd	3	0.3
Gray with black & white sherd	5	0.5
Gray with white sherd	16	1.5
Chuska gray homogeneous	171	16.3
Tan to brown clay	180	17.1
Black clay	100	9.5
White clay	23	2.2
Total	1,052	100.0

Vitrification	No.	%
None	157	14.4
Present	782	71.8
Marked	150	13.8
Total	1,089	100.0

Paste Diversity $H' = 1.420$
$s = 9$ $J = 0.646$

WHITEWARES

Mineral-on-white Types

Unpolished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white

References: Morris (1939:145-156); Roberts (1929:107-124)

Synonyms:

Primarily La Plata, some White Mound Black-on-white
Chuska Mineral: Crozier Black-on-white (4.4 percent)
Mesa Verde: Chapin Black-on-white (8.8 percent)

Similar types:

Chuska Carbon: Theodore Black-on-white
Tusayan: Lino Black-on-gray

Production span: A.D. 550 to 750

Table: 2A.11

Description:

Polished and unpolished mineral-on-white overlap temporally and in design use, but the unpolished group is likely to be on the whole earlier. To some extent this can be seen in the site distribution: unpolished is more abundant at 29SJ 628 and 29SJ 724, while the reverse is true at 29SJ 627 and 29SJ 629. At several other sites with early components (29SJ 299-BMIII, 29SJ 423, and 29SJ 721), however, polished is more abundant than unpolished. Fugitive red wash was present on more than a fourth of vessels of this type, mostly on bowl exteriors; bowls are the main form in this type, with closed forms being rare.

Peckham and Wilson (1964) do not specify Chuska Whiteware types in this time period, and the first mineral-painted type in their series, Crozier Black-on-white, is slipped and polished. There are, however, trachyte-tempered sherds in this design and surface treatment group in the Chaco Project collection, perhaps suggesting that such wares were in production earlier than their surface collections indicated. Relative to polished specimens, unpolished sherds with trachyte temper are rare; moreover, only one of 87 Basketmaker III-Pueblo I painted (including both mineral and carbon paints) sherds comes from a context likely to Basketmaker III, tending to confirm more than refute placement of decorated Chuskan wares at around A.D. 800.

Figures: 2A.6 and 2A.7

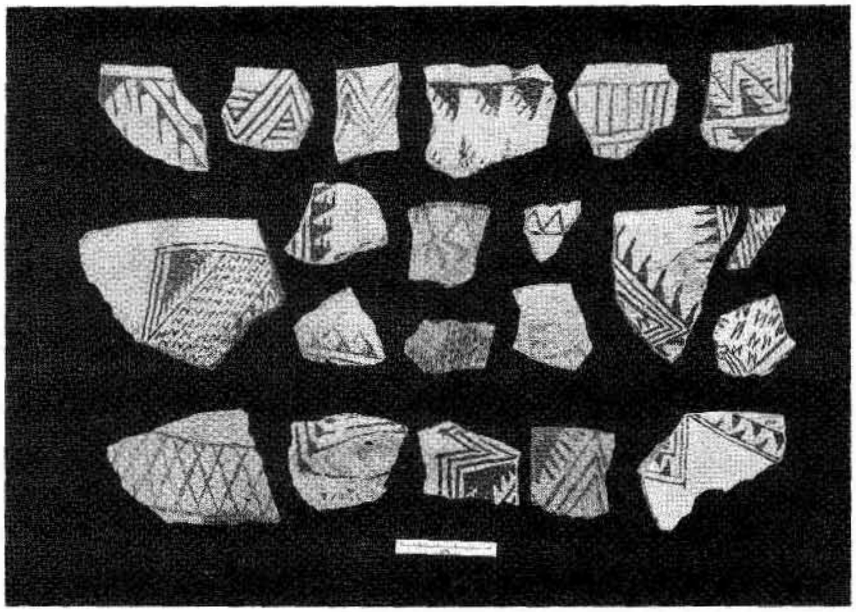


Figure 2A.6. *Sherds from 29SJ 628 showing design, execution, and finish of early painted wares in Chaco Canyon. (NPS Chaco Archive Negative No. 31938).*

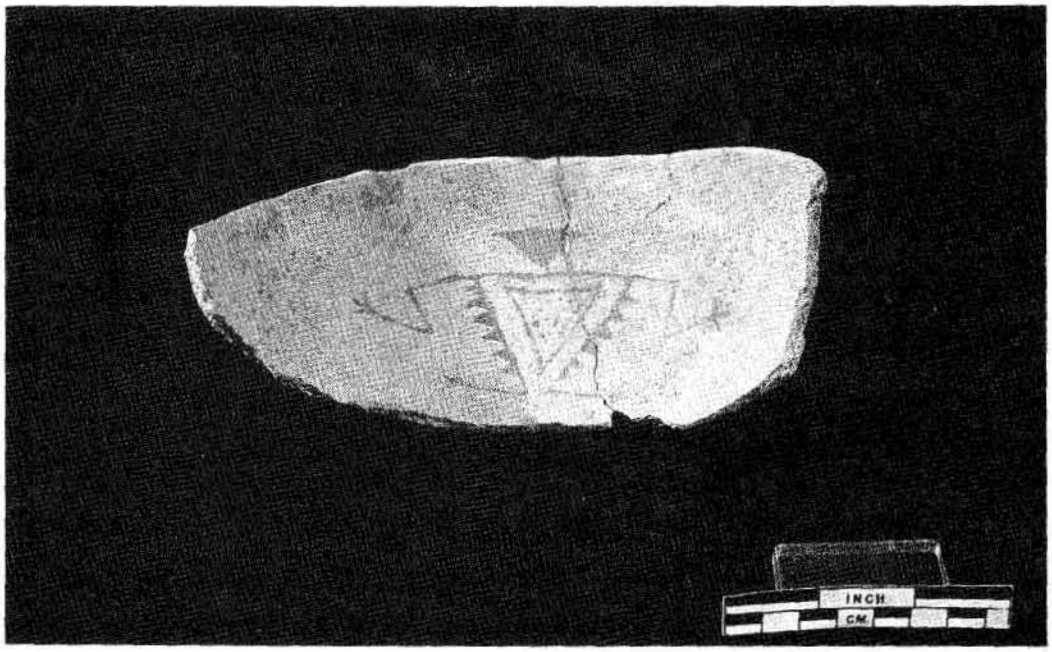


Figure 2A.7. *Bowl fragment from 29SJ 299, Pithouse D. This anthropomorphic figure is often seen in bowls from this era (Basketmaker III-Pueblo I Mineral-on-white). (NPS Chaco Archive Negative No. 13984).*

Table 2A.11. *Unpolished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white definition.*

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	34	7.2	6.8
29SJ 299 PI	11	2.3	4.5
Pueblo Alto	2	0.4	0.04
29SJ 423	9	1.9	1.4
29SJ 627	66	14.0	0.9
29SJ 628	120	25.5	13.9
29SJ 629	43	9.1	2.5
29SJ 633	-	-	-
29SJ 721	13	0.2	9.1
29SJ 724	133	28.3	24.5
29SJ 1360	34	7.2	1.6
Shabik'eshchee	5	1.1	2.6
Total	470	97.2	2.3

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Isolated single elements	3	1	-	4	0.8
Hooks, flags	32	8	-	40	7.5
Nested isolates	12	-	1	13	2.4
Overlapping steps	1	-	-	1	0.2
Nonoverlapping steps	6	-	-	6	1.1
Parallel lines	145	11	2	158	29.7
Cribbed parallel lines	4	-	-	4	0.8
Pendant parallel lines	4	1	-	5	0.9
Framers with unticked solids	12	2	-	14	2.6
Framers with ticked solids	1	-	-	1	0.2
Irregular wide lines	8	-	-	8	1.5
Ticking	5	14	16	35	6.6
Corner triangles	3	24	1	28	5.3
Scrolls	9	1	-	10	1.9
Framed slashes	-	-	1	1	0.2
Dots	17	2	-	19	3.6
Other framed isolates	4	-	1	5	0.9
Dotted lines	13	8	-	21	3.9
Thick wavy lines	-	1	-	1	0.2
Checkerboard	11	-	-	11	2.1
Eyed solids	-	1	-	1	0.2
Sawteeth	22	10	-	32	6.0
Barbs	5	4	1	10	1.9
Solid band design	3	-	1	4	0.8
General solids	37	14	2	53	10.0
Hachure A-1	4	3	-	7	1.3
Hachure A-2	1	-	-	1	0.2
Hachure B-7	1	-	-	1	0.2
Counterchange	1	-	-	1	0.2

Table 2A.11. (continued)

	Motif No.				
Designs	1	2	3	No.	%
Hatched checkerboard	2	-	-	2	0.4
Squiggle lines	2	2	-	4	1.9
Solid ticked triangles	2	2	-	4	0.8
Exterior bowl motif	1	2	3	6	1.1
Jar neck motif	2	-	-	2	0.4
Narrow Sosi style	11	2	-	13	2.4
Others, hatched	5	1	-	6	1.1
Totals	389	114	29	532	100.2
No. with 1, 2, 3 treatments	275	85	29	389	-
% with 1, 2, 3 treatments	70.7	21.9	7.5	-	100.1

Design Diversity H' = 2.721
s = 36 J = 0.759
Design Distribution H' = 0.718
s = 3 J = 0.653

2. Paint

Type		No.	%
Mineral:	red	43	9.2
	brown	240	51.6
	green	5	1.1
	black	170	36.6
Carbon		4	0.9
Unknown		3	0.6
Total		465	100.1

Rim Decoration	No.	%
Unpainted	65	13.8
Solid line	162	34.5
Dotted	1	0.2
Eroded, solid	8	1.7
Use-ground	4	0.9
Unknown	230	48.9
Total	470	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	1	0.3	3	3.9	4	0.9
None	355	90.5	71	92.2	426	90.8
One side						
Streaky	13	3.3	2	2.6	15	3.2
Moderate	17	4.3	1	1.3	18	3.8
Completely polished	1	.3	-	-	1	0.2
Both sides						
Streaky	2	0.5	-	-	2	0.4
Moderate	3	0.8	-	-	3	0.6
Totals	392	83.4	77	16.4	469	99.9

4. Slip

	Open		Closed		Total	
Location	No.	%	No.	%	No.	%
Absent	378	96.4	72	92.3	450	95.7
Interior	8	2.0	-	-	8	1.7
Exterior	-	-	3	3.8	3	0.6
Slipslop	-	-	-	-	-	-
Both sides	4	1.0	-	-	4	0.9
Unknown	2	0.5	3	3.8	5	1.1
Totals	392	83.4	78	16.6	470	100.0

Table 2A.11. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	389	82.8	167	60-330	161.1	42.989	26.7
Ladle	3	0.6	2	120-195	157.5	53.033	33.7
Jar	58	12.3	9	40-180	100.6	50.587	50.3
Olla	1	0.2	-	-	-	-	-
Pitcher	4	0.9	2	50- 55	52.5	3.536	6.7
Tecomate	12	2.6	9	60-140	95.0	32.692	48.5
Duck pot	2	0.4	-	-	-	-	-
Unknown	1	0.2					
Total	470	100.0					

Diversity of Forms H' = 0.617
s = 7 J = 0.317

6. Handles

Type	No.	%
Solid coil	1	8.3
Multi-coil	1	8.3
Strap	3	25.0
Nubbin	1	8.3
Strap lug	2	16.7
Perforated lug	4	33.3
Total	12	100.0

Handles:items = 1:49
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	332	70.9
Blackening	10	2.1
Fugitive red	126	26.8
Total	468	99.8

Worked sherds = 7 (1.5%).

Table 2A.11. (continued)

8. Designs by Vessel Form

Designs	Bowl	Ladle	Pitcher	Tecomate	Duck Pot	Olla	Jar	Total
Isolated single elements	3	-	-	-	-	-	1	4
Hooks, flags	28	-	1	2	-	1	8	40
Nested isolates	12	-	-	-	-	-	1	13
Overlapping steps	-	-	-	-	-	-	1	1
Nonoverlapping steps	3	-	-	-	-	-	3	6
Parallel lines	127	2	2	4	1	1	21	158
Cribbed parallel lines	2	-	-	-	-	-	2	4
Pendant parallel lines	5	-	-	-	-	-	-	5
Framers with unticked solids	11	-	-	-	-	-	3	14
Framers with ticked solids	1	-	-	-	-	-	-	1
Irregular wide lines	8	-	-	-	-	-	-	8
Ticking	30	-	1	-	-	-	4	35
Corner triangles	24	-	-	-	1	-	3	28
Scrolls	6	-	-	1	-	-	3	10
Framed slashes	1	-	-	-	-	-	-	1
Dots	18	-	-	-	-	-	1	19
Other framed isolates	4	-	-	-	-	-	1	5
Dotted lines	18	-	-	-	-	-	3	21
Thick wavy lines	1	-	-	-	-	-	-	1
Checkerboard	9	-	-	2	-	-	-	11
Eyed solids	1	-	-	-	-	-	-	1
Sawteeth	27	-	1	1	-	-	3	32
Barbs	9	-	-	-	-	-	1	10
Narrow Sosi style	13	-	-	-	-	-	-	13
Solid band design	3	-	-	-	-	-	1	4
General solids	41	-	-	2	-	-	9	52
Hachure A-1	5	-	1	-	1	-	-	7
Hachure A-2	1	-	-	-	-	-	-	1
Hachure B-7	1	-	-	-	-	-	-	1
Counterchange	1	-	-	-	-	-	-	1
Hatched checkerboard	-	-	-	1	-	-	1	2
Squiggle lines	3	-	-	-	-	-	1	4
Solid ticked triangles	3	-	-	1	-	-	-	4
Bowl exterior motif	6	-	-	-	-	-	-	6
Jar neck motif	-	-	-	-	-	-	2	2
Other hachure	4	-	1	-	-	-	1	6
Total designs	428	2	7	15	3	2	74	531
% of design	80.6	0.4	1.3	2.8	0.6	0.4	13.9	-
Vessel count	389	3	4	12	2	1	58	469
% of vessels	82.9	0.6	0.9	2.6	0.4	0.2	12.4	-

Table 2A.11. (continued)

B. PASTE

1. Temper Composition

Temper	No.	%
Undifferentiated sandstone (n=364, 78.1%)		
Fine to medium sandstone > sherd	75	16.1
Fine to medium sandstone < sherd	7	1.5
Coarse sandstone > sherd	277	59.4
Coarse sandstone < sherd	5	1.1
All chalcedonic sandstone*	12	2.6
Sandstone with rounded iron oxide	23	4.9
Magnetitic sandstone	13	2.8
Trachyte	8	1.7
Trachyte > sandstone	1	0.2
San Juan igneous with hornblende	32	6.9
San Juan igneous with hornblende + sandstone	3	0.6
San Juan igneous without hornblende	5	1.1
San Juan igneous without hornblende + sandstone	1	0.2
Unidentified igneous	2	0.4
Unidentified igneous with sandstone	1	0.2
Total	466	99.9

*Varieties specified: n = 5.

Temper Diversity H' = 0.947
s = 13 J = 0.369

2. Texture Attributes

Grain Size	No.	%
Fine	10	2.2
Medium	95	20.4
Coarse	296	63.5
Very coarse	65	13.9
Total	466	100.0

Density	No.	%
1-2%	2	1.1
5%	41	23.4
10%	88	50.3
20%	41	23.4
30%	3	1.7
> 40%	-	-
Total	175	99.9

Sherd Temper	No.	%
None	434	92.9
< half	21	4.5
> half	12	2.6
All	-	-
Total	467	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	5	1.4
Medium	77	21.1
Coarse	230	63.2
Very coarse	52	14.3
Total	364	100.0

Texture Index	No.	%
Very fine (0-2)	4	2.5
Fine (2.1-4)	8	5.0
Fine-medium (4.1-7)	15	9.3
Medium (7.1-10)	19	11.8
Medium-coarse (10.1-13)	31	19.3
Coarse (13.1-16)	38	23.6
Very coarse (16.1+)	46	28.6
Total	161	100.1

Table 2A.11. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	104	57.8
Black with white sherd	4	2.2
Gray with black sherd	1	0.6
Gray with black and white sherd	6	3.3
Gray with white sherd	7	3.9
Tan to brown clay	15	8.3
Black clay	8	4.4
White clay	35	19.4
Total	180	99.9

Vitrification	No.	%
Absent	190	62.1
Present	73	23.9
Marked	43	14.1
Total	306	100.1

Paste Diversity H' = 1.334
s = 8 J = 0.645

Polished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white

References: Gladwin (1945)

Synonyms:

White Mound Black-on-white, some La Plata Black-on-white
Chuska Mineral: Crozier Black-on-white (4.4 percent)
Mesa Verde: Chapin, Piedra Black-on-whites (9.3 percent)

Similar types:

Chuska Carbon: Theodore, Peña[1] Black-on-whites
Tusayan: Kana'a Black-on-white

Production span: A.D. 700 to 850

Table: 2A.12

Description:

Motif occurrence in this type is overall similar to that in the unpolished group, although hachure is considerably more common in this somewhat later type. Though the elements are similar, there is a trend toward fuller, more symmetrical design fields. In addition to greater polish, this type uses considerably more slip than Unpolished Basketmaker III-Pueblo I. Paste tends to be finer textured and more highly fired, including smaller grain sizes and more sherd temper.

Although this type name has appeared in print as "Pena" (e.g., Warren 1967; Windes 1977, 1984b; Goetze and Mills 1993), Stewart Peckham (personal communication 1995) indicates that the name came from Peña Blanca Wash and that the ñ is correct. Rather than pain or punishment Black-on-white, then, it is rock or boulder Black-on-white.

Table 2A.12. Polished Basketmaker III-Pueblo I (BMIII-PI) Mineral-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	38	6.5	7.6
29SJ 299 PI	11	1.9	4.5
Pueblo Alto	-	-	-
29SJ 423	37	6.3	5.8
29SJ 627	94	16.0	1.3
29SJ 628	87	14.8	10.0
29SJ 629	144	24.4	8.4
29SJ 633	-	-	-
29SJ 721	26	4.4	18.2
29SJ 724	69	11.7	12.7
29SJ 1360	58	9.8	2.8
Shabik'eshchee	25	4.2	13.0
Total	589	100.0	2.9

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Isolated single elements	5	2	1	8	1.2
Hooks, flags	52	29	1	82	12.0
Nested isolates	10	1	3	14	2.1
Unnested isolates	1	-	-	1	0.1
Nonoverlapping steps	3	4	-	7	1.0
Parallel lines	112	15	1	128	18.7
Cribbed parallel lines	3	2	-	5	0.7
Pendant parallel lines	13	-	-	13	1.9
Framers with unticked solids	34	-	-	34	5.0
Framers with ticked solids	5	-	1	6	0.9
Irregular wide lines	3	-	-	3	0.4
Ticking	12	30	8	50	7.3
Corner triangles	3	12	2	17	2.5
Scrolls	7	3	1	11	1.6
Framed slashes	2	-	-	2	0.3
Dots	33	9	-	42	6.1
Other framed isolates	8	-	-	8	1.2
Framing dots	-	1	1	2	0.3
Dotted lines	17	8	2	27	4.0
Checkerboard	8	2	-	10	1.5
Sawteeth	23	4	2	29	4.2
Barbs	3	6	-	9	1.3
Wide Sosi style	1	-	-	1	0.1
Heavy dotted lines	1	-	-	1	0.1
Heavy curvilinear lines	1	-	-	1	0.1
Solid band deign	6	-	-	6	0.9
Isolated triangles	1	-	-	1	0.1
General solids	45	21	5	71	10.4

***Table 2A.12.** (continued)*

	Motif No.				
Designs	1	2	3	No.	%
Hachure A-1	26	6	1	33	4.8
Hachure A-2	1	-	-	1	0.1
Hachure A-3	2	1	-	3	0.4
Hachure B-2	1	-	-	1	0.1
Squiggle lines	9	3	1	13	1.9
Anthro/zoomorphs	4	-	1	5	0.7
Solid ticked triangles	4	2	-	6	0.9
Exterior bowl motif	2	2	2	6	0.9
Jar neck motif	1	-	-	1	0.1
Narrow Sosi style	14	-	-	14	2.1
Narrow curvilinear lines	5	-	-	5	0.7
Others, solid		-	-	1	0.1
Others, hatched	4	-	-	4	0.6
Banded, undifferentiated	1	1	-	2	0.3
Totals	487	164	33	684	99.7
No. with 1, 2, 3 treatments	323	131	33	487	-
% with 1, 2, 3 treatments	66.3	26.9	6.8	-	100.0

Type Design Diversity H' = 2.944
s = 42 J = 0.789
Design Distribution Diversity H' = 0.808
s = 3 J = 0.735

2. Paint

Type		No.	%
Mineral:	red	116	20.0
	brown	256	44.9
	green	9	1.6
	black	180	31.6
	glaze	1	0.2
Carbon		2	0.4
Unknown		9	1.4
Total		573	100.1

Rim Decoration	No.	%
Unpainted	101	17.2
Solid line	210	35.7
Eroded, solid	15	2.6
Use-ground	8	1.4
Unknown	254	43.2
Total	588	100.1

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	11	2.1	-	-	11	1.9
None	29	5.5	9	15.3	38	6.5
One side						
Streaky	34	6.4	5	8.5	39	6.6
Moderate	169	31.9	23	39.0	192	32.7
Completely polished	122	23.1	22	37.3	144	24.5
Both sides						
Streaky	8	1.5	-	-	8	1.4
Moderate	51	9.6	-	-	51	8.7
Completely polished	61	11.5	-	-	61	10.4
Differential interior/ exterior polish	44	8.3	-	-	44	7.5
Totals	529	90.0	59	10.0	588	99.9

Table 2A.12. (continued)

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	384	72.6	45	76.3	429	73.0
Interior	48	9.1	-	-	48	8.2
Exterior	-	-	11	18.6	11	1.9
Slipslop	2	0.4	1	1.7	3	0.5
Both sides	79	14.9	-	-	79	13.4
Unknown	16	3.0	2	3.4	18	3.1
Totals	529	90.0	59	10.0	588	100.1

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	516	87.6	258	65-350	165.8	46.314	27.9
Ladle	13	2.2	10	60-170	102.5	38.891	37.9
Jar	49	8.3	3	90-150	110.0	34.600	31.5
Pitcher	2	0.3	2	55-100	77.5	31.820	41.1
Seed jar	2	0.3	2	35-130	82.5	67.175	81.9
Tecomate	5	0.9	3	55-80	71.7	14.434	62.0
Gourd jar	1	0.2	-	-	-	-	-
Unknown	1	0.2					
Total	589	100.0					

Diversity of Forms H' = 0.496
s = 7 J = 0.255

6. Handles

Type	No.	%
Solid coil	3	27.3
Trough	5	45.5
Strap lug	1	9.0
Perforated nubbin lug	2	18.2
Total	11	100.0

Handles:Items = 1:96
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	447	76.1
Blackening	28	4.8
Fugitive red	111	18.8
Mineral deposit	1	0.2
Total	587	99.9

Worked sherds = 23 (3.9%).

Table 2A.12. (continued)

8. Designs by Vessel Form

Designs	Bowl	Ladle	Pitcher	Seed Jar	Gourd Jar	Tecomate	Jar	Total
Isolated single elements	6	-	-	-	-	2	-	8
Hooks, flags	67	5	-	-	1	1	8	82
Nested isolates	8	2	-	-	-	-	4	14
Unnested isolates	1	-	-	-	-	-	-	1
Nonoverlapping steps	6	1	-	-	-	-	-	7
Parallel lines	112	1	-	1	-	-	14	128
Cribbed parallel lines	3	-	-	-	1	-	1	5
Pendant parallel lines	11	-	-	-	-	1	1	34
Framers with unticked solids	30	2	-	-	-	1	1	34
Framers with ticked solids	4	-	-	-	-	-	2	6
Irregular wide lines	3	-	-	-	-	-	-	3
Ticking	38	1	-	-	-	-	11	50
Corner triangles	13	-	-	-	-	-	4	17
Scrolls	7	-	-	-	-	-	4	11
Framed slashes	1	-	-	-	-	-	1	2
Dots	41	1	-	-	-	-	-	42
Other framed isolates	8	-	-	-	-	-	-	8
Framing dots	2	-	-	-	-	-	-	2
Dotted lines	20	1	-	-	-	-	6	27
Checkerboard	8	-	-	-	-	-	2	10
Sawteeth	27	1	-	1	-	-	-	29
Barbs	7	-	-	-	-	-	2	9
Wide Sosi style	1	-	-	-	-	-	-	1
Narrow Sosi style	12	-	-	-	-	-	2	14
Heavy dotted lines	1	-	-	-	-	-	-	1
Heavy curvilinear line	1	-	-	-	-	-	-	1
Solid band design	4	-	-	1	-	-	1	6
Isolated triangles	1	-	-	-	-	-	-	1
General solids	61	-	-	-	-	1	9	71
Hachure A-1	31	-	-	-	-	-	2	33
Hachure A-2	1	-	-	-	-	-	-	1
Hachure A-3	3	-	-	-	-	-	-	3

Table 2A.12. *(continued)*

Designs	Bowl	Ladle	Pitcher	Seed Jar	Gourd Jar	Tecomate	Jar	Total
Hachure B-2	1	-	-	-	-	-	-	
Squiggle lines	11	2	-	-	-	-	-	13
Zoomorphs	4	1	-	-	-	-	-	5
Solid ticked triangles	6	-	-	-	-	-	-	6
Exterior bowl motif	6	-	-	-	-	-	-	6
Jar neck motif	-	-	1	-	-	-	-	1
Narrow curvilinear line	4	-	-	-	-	-	-	4
Other solids	-	-	-	-	-	-	1	1
Other hachure	4	-	-	-	-	-	-	4
Total designs	575	18	1	3	2	6	77	682
% of design	84.3	2.6	0.2	0.4	0.3	0.9	11.3	
Vessel count	516	13	2	2	1	5	49	588
% of vessels	87.6	2.2	0.4	0.4	0.2	0.9	8.3	

Table 2A.12. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=424, 74.5%)		
Fine to mdium sandstone > sherd	108	19.0
Fine to medium sandstone < sherd	56	9.8
Coarse sandstone > sherd	245	43.1
Coarse sandstone < sherd	15	2.6
All chalcedonic sandstone	22*	3.9
Sandstone with rounded iron oxide	23	4.0
Magnetitic sandstone	20	3.5
Trachyte	19	3.3
Trachyte >sandstone	6	1.0
Sandstone >trachyte	1	0.2
San Juan igneous with hornblende	33	5.8
San Juan igneous with hornblende + sandstone	5	0.9
San Juan igneous without hornblende	6	1.0
San Juan igneous without hornblende + sandstone	6	1.0
Sandstone with San Juan igneous without hornblende	2	0.4
Sandstone with andesite	1	0.2
Socorro volcanics + sandstone	1	0.2
Total	569	99.9

*Varieties specified: pink, n = 6.

Temper Diversity H' = 1.099
s = 14 J = 0.421

2. Texture Attributes

Grain Size	No.	%
Fine	30	5.3
Medium	193	33.9
Coarse	295	51.8
Very coarse	51	9.0
Total	569	100.0

Density	No.	%
1-2%	3	0.8
5%	71	19.9
10%	170	47.6
20%	104	29.1
30%	6	1.7
>40%	3	0.8
Total	357	99.9

Sherd Temper	No.	%
None	414	72.8
< half	76	13.3
> half	77	13.5
All	2	0.4
Total	569	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	23	5.4
Medium	141	33.3
Coarse	220	51.9
Very coarse	40	9.4
Total	424	100.0

Texture Index	No.	%
Very fine (0-2)	27	8.8
Fine (2.1-4)	52	16.9
Fine-medium (4.1-7)	58	18.8
Medium (7.1-10)	49	15.9
Medium-coarse (10.1-13)	33	10.7
Coarse (13.1-16)	57	18.5
Very coarse (16.1+)	32	10.4
Total	308	100.0

Table 2A.12. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	167	46.5
Black with white sherd	20	5.6
Gray with black sherd	11	3.1
Gray with, black & white sherd	12	3.3
Gray with white sherd	28	7.8
Chuska gray homogeneous	5	1.4
Tan to brown clay	51	14.2
Black clay	11	3.1
White clay	54	15.0
Total	359	100.0

Vitrification	No.	%
Absent	180	41.8
Present	198	45.9
Marked	53	12.3
Total	431	100.0

Paste Diversity $H' = 1.665$
$s = 9$ $J = 0.758$

Early Red Mesa Black-on-white

References: Roberts (1931); Toll and McKenna (1993:37-38); Vivian (1965); Windes (1984b)

Synonyms:

Kiatuthlanna Black-on-white
Chuska Mineral: Drolet, Naschitti Black-on-whites (2.9 percent)

Similar types:

Chuska Carbon: Peña, Tunicha, Newcomb Black-on-whites
Mesa Verde: Piedra, Cortez Black-on-white (1.1 percent%)
Tusayan: Kana'a Black-on-white

Production span: A.D. 850 to 925

Table: 2A.13

Description:

Vivian (1965) discussed the difficulties he experienced in separating Kiatuthlanna from Red Mesa Black-on-white, and questioned the existence of both types in Chaco Canyon. The difference between "Early Red Mesa" and Red Mesa in the Chaco Project analysis is primarily in layout, with Early Red Mesa designs being most often pendant from the rim, often with a large undecorated area in the interior bottom of bowls (see Peckham 1990:67, 68, 70, 71), or sometimes open areas around an isolated panel in the bottom of the bowl. These designs tend to intersect the bowl rim at an angle, rather than running parallel to it (Figure 2A.8). What few sherds were identified as Kiatuthlanna Black-on-white were identified by the presence of this type of design layout in combination with somewhat brownish paint and a smooth, cream-colored slip.

Modally, pottery classified as Early Red Mesa Black-on-white has the whiter, duller, thinner slip common to much of the Chaco Cibola series, and variations of black paint, although brown mineral paint is common at this time and in this type. Line work in this group tends to be fine, with much use of parallel lines framing other motifs. On the whole, the quality of production of this group in decoration, polish, and vessel walls is high relative to the bulk of Red Mesa Black-on-white and to preceding types. Distributions of temper, forms, polishing, and slipping are similar to those of Red Mesa Black-on-white.

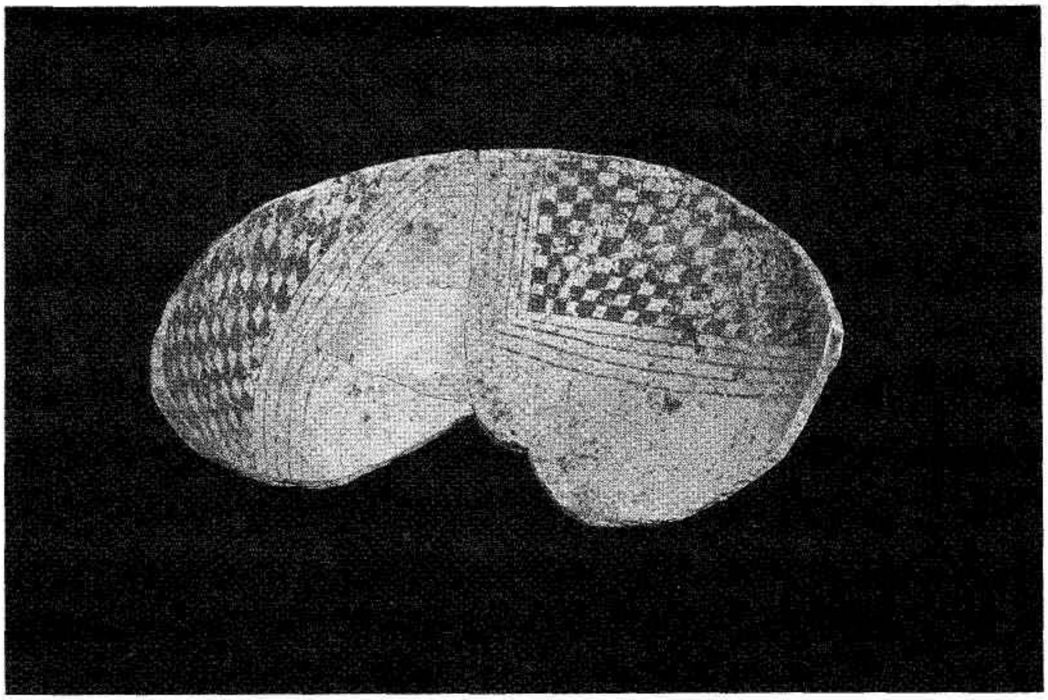


Figure 2A.8. *Bowl (Early Red Mesa Black-on-white) from 29SJ 629 showing design pendant from the rim and three-part division of field. (NPS Chaco Archive Negative No. 15962).*

Table 2A.13. Early Red Mesa Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	3	0.8	0.6
29SJ 299 PI	3	0.8	1.2
Pueblo Alto	21	5.3	0.4
29SJ 423	-	-	-
29SJ 627	155	39.0	2.1
29SJ 628	3	0.8	0.3
29SJ 629	96	24.2	5.6
29SJ 633	-	-	-
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	116	29.2	5.6
Shabik'eshchee	-	-	-
Total	397	100.1	2.0

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	4	3	1	8	1.4
Nested isolates	6	-	-	6	1.1
Nonoverlapping steps	1	2	-	3	0.5
Parallel lines	121	18	2	141	24.8
Cribbed parallel lines	8	2	2	12	2.1
Pendant parallel lines	8	9	3	20	3.5
Framers with unticked solids	80	7	1	88	15.5
Framers with ticked solids	69	2	-	71	12.5
Ticking	-	1	1	2	0.3
Corner triangles	1	5	3	9	1.6
Scrolls	7	17	3	27	4.8
Dots	1	-	-	1	0.2
Framing dots	-	1	1	2	0.3
Dotted lines	8	15	6	29	5.1
Checkerboard	2	3	-	5	0.9
Sawteeth	13	8	1	22	3.9
Barbs	2	-	1	3	0.5
Wide Sosi style	1	1	-	2	0.3
Solid band design	25	5	-	30	5.3
Hatched band design	1	-	-	1	0.2
General solids	4	9	-	13	2.3
Hachure A-1	10	9	-	19	3.3
Hachure A-2	-	1	-	1	0.2
Squiggle lines	6	2	1	9	1.6
Solid ticked triangles	4	10	3	17	3.0
Exterior bowl motif	-	2	-	2	0.3
Narrow Sosi style	12	1	1	14	2.5
Interlocked ticking	3	6	-	9	1.6
Others, solid	-	2	-	2	0.3
Totals	397	141	30	568	99.9

Table 2A.13. (continued)

Designs	Motif No. 1	2	3	No.	%
No. with 1, 2, 3 treatments	256	111	30	397	-
% with 1, 2, 3 treatments	64.5	28.0	7.6	-	100.1

Type Design Diversity H' = 2.604
s = 29 J = 0.773
Design Distribution Diversity H' = 0.752
s = 3 J = 0.684

2. Paint

Type		No.	%
Mineral:	red	16	4.0
	brown	109	27.5
	green	2	0.5
	black	266	67.0
	glaze	4	1.0
Total		397	100.0

Rim Decoration	No.	%
Unpainted	33	8.3
Solid line	257	64.9
Eroded, solid	23	5.8
Use-ground	18	4.5
Unknown	65	16.4
Total	396	99.9

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	18	5.4	1	1.6	19	4.8
None	7	2.1	3	4.8	10	2.5
One side						
Streaky	5	1.5	4	6.3	9	2.3
Moderate	21	6.3	6	9.5	27	6.8
Completely polished	95	28.4	49	77.8	144	36.3
Both sides						
Streaky	2	0.6	-	-	2	0.5
Moderate	5	1.5	-	-	5	1.3
Completely polished	76	22.8	-	-	76	19.1
Differential interior/exterior polish	105	31.4	-	-	105	26.4
Totals	334	84.1	63	15.9	397	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	16	4.8	6	9.5	22	5.5
Interior	74	22.2	-	-	74	18.6
Exterior	-	-	50	79.4	50	12.6
Slipslop	8	2.4	5	7.9	13	3.3
Both sides	216	64.7	-	-	216	54.4
Unknown	20	6.0	2	3.2	22	5.5
Totals	334	84.1	63	15.9	397	99.9

Table 2A.13. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	315	79.3	261	80-350	193.3	47.934	24.8
Ladle	19	4.8	13	50-165	93.5	33.100	35.1
Jar	46	11.6	7	35-230	99.3	66.922	67.4
Olla	5	1.2	3	6-80	71.7	10.408	14.5
Pitcher	6	1.5	3	65-85	73.3	10.408	14.2
Seed jar	1	0.2	1	50	-	-	-
Canteen	2	0.5	-	-	-	-	-
Duck pot	1	0.2	1	50	-	-	-
Gourd jar	2	0.5	2	20-40	30.0	14.142	47.1
Total	397	100.0					

Diversity of Forms H' = 0.781
s = 9 J = 0.355

6. Handles

Type	No.	%
Multi-coil	1	5.0
Strap	4	20.0
Trough	8	40.0
Nubbin	1	5.0
Strap lug	3	15.0
Perforated nubbin lug	2	10.0
Effigy	1	5.0
Total	20	100.0

Handles:items = 1:20
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
Sooting	1	0.3
None	373	94.0
Blackening	20	5.0
Fugitive red	2	0.5
Mineral incrustation	1	0.3
Total	397	100.1

Worked sherds = 46 (11.6%).

Table 2A.13. (continued)

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Canteen	Pitcher	Seed Jar	Gourd Jar	Duck Pot	Olla	Jar	Total
Hooks, flags	8	-	-	-	-	-	-	-	-	8
Nested isolates	5	-	1	-	-	-	-	-	-	6
Nonoverlapping steps	2	1	-	-	-	-	-	-	-	3
Parallel lines	127	3	-	-	-	-	-	-	11	141
Cribbed parallel lines	9	-	-	-	-	-	-	-	3	12
Pendant parallel lines	16	1	-	-	-	-	-	1	2	20
Framers with unticked solids	62	5	1	4	1	1	-	2	12	88
Framers with ticked solids	59	-	-	1	-	-	-	1	10	71
Ticking	2	-	-	-	-	-	-	-	-	2
Corner triangles	7	1	-	-	-	-	-	-	1	9
Scrolls	21	3	-	1	-	-	-	-	2	27
Dots	-	-	-	-	-	-	-	-	1	1
Framing dots	1	-	-	-	-	-	-	-	1	2
Dotted lines	20	1	-	-	-	-	-	-	8	29
Checkerboard	5	-	-	-	-	-	-	-	-	5
Sawteeth	17	3	-	-	-	-	-	-	2	22
Barbs	2	-	-	-	-	-	-	-	1	3
Wide Sosi style	1	-	-	-	-	-	-	1	-	2
Narrow Sosi style	11	-	-	1	-	-	-	-	2	14
Solid band design	21	3	-	1	-	1	1	1	2	30
Hatched band motifs	1	-	-	-	-	-	-	-	-	1
General solids	12	-	-	-	-	-	-	-	1	13
Hachure A-1	6	2	-	-	-	-	1	1	9	19
Hachure A-2	-	1	-	-	-	-	-	-	-	1
Squiggle lines	8	1	-	-	-	-	-	-	1	10
Solid ticked triangles	12	3	-	1	-	-	-	1	-	17
Bowl exterior motif	2	-	-	-	-	-	-	-	-	2
Interlocked ticking	4	2	-	-	-	1	-	1	1	9
Others, solid	2	-	-	-	-	-	-	-	-	2
Total designs	443	30	2	9	1	3	2	9	70	569
% of designs	77.8	5.3	0.4	1.6	0.2	0.5	0.4	1.6	12.3	
Total vessels	315	19	2	6	1	2	1	5	46	397
% of vessels	79.4	4.8	0.5	1.5	0.2	0.5	0.2	1.2	11.6	

Table 2A.13. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=306, 80.9%)		
Fine to medium sandstone > sherd	92	24.3
Fine to medium sandstone < sherd	171	45.2
Coarse sandstone > sherd	17	4.5
Coarse sandstone < sherd	26	6.9
All chalcedonic sandstone*	33	8.7
Trachyte	2	0.5
Trachyte > sandstone	9	2.4
Sandstone > trachyte	6	1.6
San Juan igneous with hornblende & sandstone	1	0.3
Sandstone with San Juan igneous with hornblende	1	0.1
San Juan igneous without hornblende with sandstone	3	0.8
Sandstone with San Juan igneous without hornblende	3	0.8
Unidentified igneous with sandstone	3	0.8
Sandstone with unidentified ingneous	6	1.6
Socorro volcanics with sandstone	2	0.5
Sandstone with Socorro volcanics	2	0.5
Total	378	100.0

*Varieties specified: pink, n = 11.

Temper Diversity H' = 0.850
s = 14 J = 0.322

2. Texture Attributes

Grain Size	No.	%
Fine	110	29.1
Medium	220	58.2
Coarse	45	11.9
Very coarse	3	0.8
Total	378	100.0

Density	No.	%
1-2%	2	0.6
5%	54	15.7
10%	126	36.7
20%	124	36.2
30%	34	9.9
>40%	3	0.9
Total	343	100.0

Sherd Temper	No.	%
None	61	16.2
<half	93	24.7
>half	215	57.0
All	8	2.1
Total	377	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	87	28.4
Medium	176	57.5
Coarse	41	13.4
Very coarse	2	0.7
Total	306	100.0

Texture Index	No.	%
Very fine (0-2)	92	26.8
Fine (2.1-4)	131	38.2
Fine-medium (4.1-7)	82	23.9
Medium (7.1-10)	26	7.6
Medium-coarse (10.1-13)	8	2.3
Coarse (13.1-16)	3	0.9
Very coarse (16.1+)	1	0.3
Total	343	100.0

Table 2A.13. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	113	32.6
Black with white sherd	45	13.0
Gray with black sherd	45	13.0
Gray with black & white	26	7.5
Gray with white sherd	75	21.6
Chuska gray homogeneous	6	1.7
Tan to brown clay	7	2.0
Black clay	7	2.0
White clay	23	6.6
Total	347	100.0

Vitrification	No.	%
Absent	55	14.8
Present	159	42.9
Marked	157	42.3
Total	371	100.0

Paste Diversity $H' = 1.828$
$s = 9$ $J = 0.832$

Red Mesa Black-on-white

References: McKenna and Toll (1984); Toll and McKenna (1992, 1993); Windes (1984b);

Synonyms:

Transitional, Hachure A (Roberts 1927)
Chuska Mineral: Naschitti Black-on-white (4.4 percent)
Mesa Verde: Cortez Black-on-white (1.2 percent)

Similar types:

Chuska Carbon: Newcomb, Tunicha, Burnham Black-on-whites (see Chuska Red Mesa Design below)
Tusayan: Wepo, Black Mesa Black-on-whites

Production span: A.D. 875 to 1040

Table: 2A.14

Description:

Red Mesa Black-on-white is the most abundant specific type in the Chaco Project collection—it was the dominant type at 29SJ 627, 29SJ 629, and 29SJ 1360, and occurred in substantial quantities at Pueblo Alto, the four largest site assemblages (Table 2.1). Its abundance in the sample is also due to its long period of production. Most Red Mesa Black-on-white designs are laid out in bands around the vessel. Common design elements include scrolls, solid triangles, usually with dots or ticks along one edge of the triangle, parallel lines, and checkerboards. The parallel lines often frame sets of interlocking scrolls or triangles or other elements. Dots and ticks are commonly added to lines as well as to triangles.

Hachure was also used extensively, and tends to include widely spaced, "squiggle" hachure lines as well as straight hachure lines that are the same line thickness as the framing lines (Roberts' Hachure A). Hachured Red Mesa Black-on-white produced in the A.D. 1000s looks increasingly like early Gallup Black-on-white, and there is little question that a continuum between Red Mesa and Gallup Black-on-whites exists (see Figure 2A.13, Toll and McKenna 1993:Plate 1.11), although there is some controversy on this point (Washburn 1980:70; Jernigan 1986:27, 30). Separation of hachured Red Mesa Black-on-white from Gallup Black-on-white is primarily contingent on Red Mesa Black-on-white framing line widths being equal to hachure lines, while Gallup Black-on-white framing lines are increasingly wider than the hachure lines. Hachure lines in Red Mesa Black-on-white are more nearly perpendicular to the framing lines and are more widely spaced than in Gallup Black-on-white. Red Mesa Black-on-white is, again, more likely to use band design layouts, while Gallup Black-on-white tends to fuller use of the design field and non-band layouts.

Bowls form a larger proportion of Red Mesa Black-on-white than of subsequent types, and closed forms are conversely low (Table 2.14B). Of 253 ladle handles, 242 are from the open, halved gourd scoop type of ladle. Even though it occurs only on ladles, this handle type dominates all Red Mesa Black-on-white handles, with strap handles most common on closed forms.

Red Mesa Black-on-white differs from Cortez Black-on-white, primarily in temper and slip and polish. Normally, Cortez Black-on-white has a thicker—often crazed—slip and is more highly polished. When a sherd had those characteristics, it was placed in the Exotic Mineral-on-white group. As can be seen from the temper counts, however, some items with San Juan igneous temper looked sufficiently like Red Mesa Black-on-white to be put in this group.

The use and production of Red Mesa Black-on-white corresponds to the use and production of narrow neckbanded and neck corrugated culinary vessels with smooth bodies. After Red Mesa Black-on-white, culinary wares were nearly all indented corrugated over their entire surfaces.

Figures: 2A.9, 2A.10, 2A.11, and 2A.12

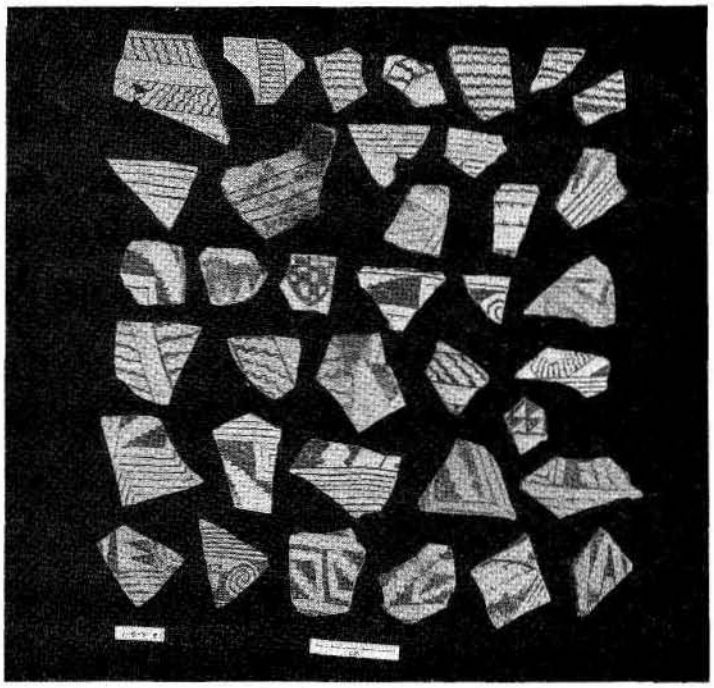


Figure 2A.9. *Red Mesa Black-on-white bowl and jar sherds (early A.D. 1000s) from Pueblo Alto Trash Mound. (NPS Chaco Archive Negative No. 23169).*

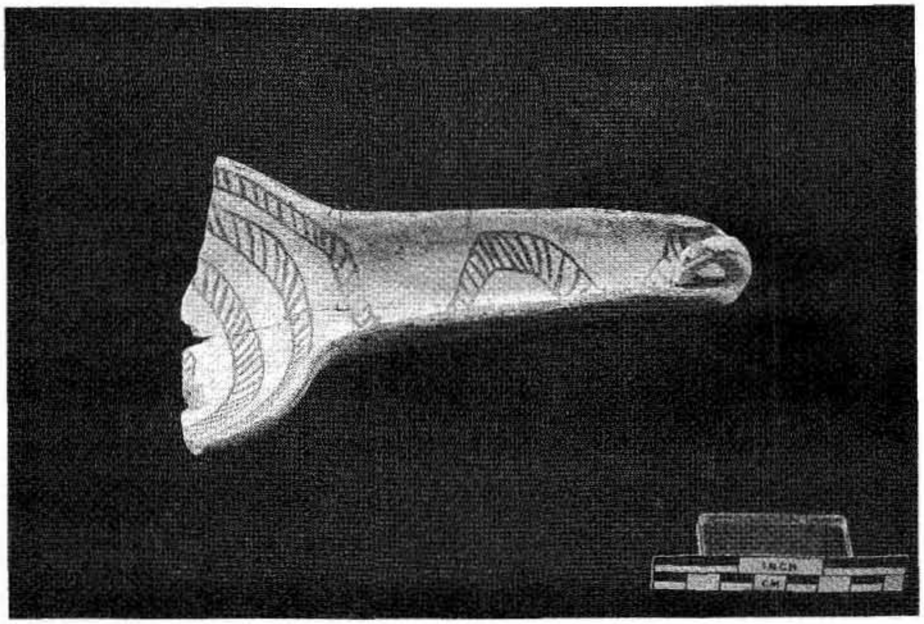


Figure 2A.10. *Red Mesa Black-on-white ladle from 29SJ 629, Room 7. (NPS Chaco Archive Negative No. 13969).*

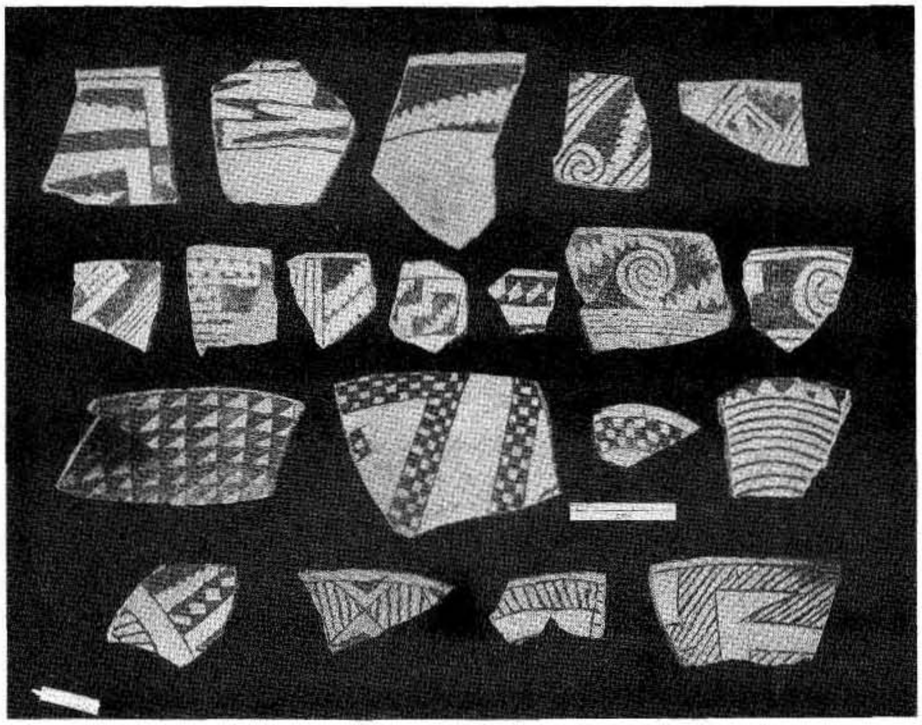


Figure 2A.11. *Bowl sherds from 29SJ 629 showing a range of Red Mesa designs including checkerboards, squiggle and Hachure A, ticked triangles, and scrolls. (NPS Chaco Archive Negative No. 31962).*

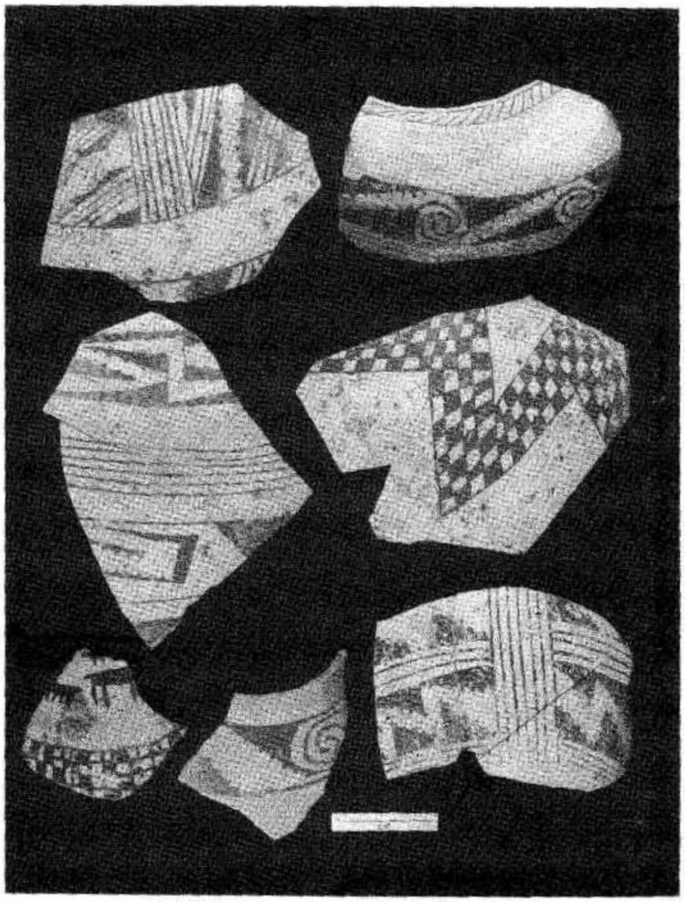


Figure 2A.12. *Red Mesa Black-on-white jar sherds from 29SJ 629. (NPS Chaco Archive Negative No. 31956).*

Table 2A.14. Red Mesa Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	14	0.4	2.8
29SJ 299 PI	14	0.4	5.7
Pueblo Alto	314	8.2	5.8
29SJ 423	-	-	-
29SJ 627	2,307	60.5	30.7
29SJ 628	2	0.1	0.2
29SJ 629	418	11.0	24.5
29SJ 633	16	0.4	5.0
29SJ 721	-	-	-
29SJ 724	1	0.03	0.2
29SJ 1360	725	19.0	34.8
Shabik'eshchee	-	-	-
Total	3,811	100.03	18.9

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	7	5	13	25	0.5
Nested isolates	10	9	-	19	0.3
Nonoverlapping steps	1	-	-	1	-
Parallel lines	299	139	26	464	8.4
Cribbed parallel lines	36	9	3	48	0.9
Pendant parallel lines	123	68	8	199	3.6
Framers with unticked solids	95	5	-	100	1.8
Framers with ticked solids	138	8	2	148	2.7
Irregular wide lines	2	-	-	2	-
Ticking	-	7	1	8	0.1
Corner triangles	2	16	8	26	0.5
Scrolls	162	330	33	525	9.5
Dots	12	5	1	18	0.3
Other framed isolates	2	-	-	2	-
Framing dots	-	13	4	17	0.3
Dotted lines	96	118	29	243	4.4
Thick wavy lines	19	17	1	37	0.7
Parallelograms	2	1	-	3	-
Checkerboard	257	10	1	268	4.9
Eyed solids	12	10	2	24	0.4
Sawteeth	157	53	18	228	4.1
Barbs	49	27	4	80	1.4
Elongated scalloped triangles	5	7	-	12	0.2
Wide Sosi style	8	2	2	12	0.2
Heavy dotted lines	10	5	1	16	0.3
Heavy curvilinear lines	-	3	-	3	-
Narrow curvilinear	2	1	-	3	-
Solid band design	1,122	72	18	1,212	21.5
Hatched band design	5	2	-	7	0.1

Table 2A.14. (continued)

Designs	Motif No. 1	2	3	No.	%
Isolated triangles	3	1	1	5	0.1
General solids	153	132	19	304	5.5
Hachure A-1	279	24	6	309	5.6
Hachure A-2	18	2	3	23	0.4
Hachure A-3	11	1	-	12	0.2
Hachure B-1	8	3	1	12	0.2
Hachure B-2	3	-	1	4	0.1
Hachure B-3	4	-	-	4	0.1
Hachure B-4	1	1	-	2	-
Hachure B-5	1	-	-	1	-
Hachure B-6	2	-	1	3	-
Hachure B/C	14	-	-	14	0.2
Hatched checkerboard	4	1	-	5	0.1
Heavy Gallup squiggle	4	1	-	5	0.1
Squiggle lines	191	64	37	292	5.3
Interlocked frets	3	-	-	3	-
Anthro/zoomorphs	-	1	-	1	-
Solid ticked triangles	344	135	21	500	9.1
Exterior bowl motif	2	26	14	42	0.8
Jar neck motif	16	7	1	24	0.4
Narrow Sosi style	25	13	-	38	0.7
Interlocked ticking	56	64	14	134	2.4
Others, solid	6	5	2	13	0.2
Others, hachure	3	8	1	12	0.2
Undifferentiated banded	-	3	-	3	-
Wide neckbanded > 5 mm	1	-	1	2	-
Narrow clapboard 2-5 mm	-	1	-	1	-
Wide clapboard > 5 mm	1	-	-	1	-
Narrow corrugated 2-5 mm	1	-	1	2	-
Wide corrugated > 5 mm	1	-	-	1	-
Totals	3,789	1,435	299	5,523	-
No. with 1, 2, 3 treatments	2,354	1,136	299	3,789	-
% with 1, 2, 3 treatments	62.1	30.0	7.9	-	100.0

Type Design Diversity H' = 2.847
s = 59 J = 0.698
Design Distribution Diversity H' = 0.767
s = 3 J = 0.698

2. Paint

Type		No.	%
Mineral:	red	52	1.4
	brown	792	20.8
	green	26	0.7
	black	2,878	75.7
	glaze	44	1.2
Carbon		7	0.2
Unknown		5	0.1
Total		3,804	100.0

Rim Decoration	No.	%
Unpainted	363	9.5
Solid line	2,450	64.3
Dotted	9	0.2
Eroded, solid line	165	4.3
Use-ground	248	6.5
Unknown	576	15.1
Total	3,811	99.9

Table 2A.14. (continued)

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	139	4.5	33	4.9	172	4.5
None	77	2.5	23	3.4	100	2.6
One side						
Streaky	78	2.5	25	3.7	103	2.7
Moderate	212	6.8	92	13.6	304	8.0
Completely polished	929	29.9	503	14.4	1,432	37.8
Both sides						
Streaky	40	1.3	-	-	40	1.1
Moderate	149	4.8	-	-	149	3.9
Completely polished	646	20.8	-	-	646	17.1
Differential interior/exterior polish	841	27.0	-	-	841	22.2
Totals	3,111	82.1	676	17.9	3,787	99.9

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	100	3.2	31	4.6	131	3.5
Interior	647	20.8	6[a]	0.9	653	17.2
Exterior	-	-	549	81.2	549	14.5
Slipslop	130	4.2	73	10.8	203	5.4
Both sides	2,121	68.2	-	-	2,121	56.0
Unknown	112	3.6	17	2.5	129	3.4
Totals	3,111	82.1	676	17.9	3,786	100.0

* Unknown forms excluded, n= 25.

[a] Pipes and effigy forms.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	2,703	70.9	2,065	10-350	186.8	56.341	30.2
Ladle	408	10.7	141	45-200	105.9	29.803	28.2
Jar	415	10.9	101	30-265	81.2	34.922	43.0
Olla	75	2.0	38	25-115	77.5	15.715	20.3
Pitcher	89	2.3	78	40-130	79.0	18.417	23.3
Tecomate	12	0.3	10	40-130	85.5	30.500	35.7
Seed jar	33	0.9	27	30-150	84.3	33.647	39.9
Canteen	15	0.4	11	20-40	31.4	5.954	19.0
Duck pot	9	0.2	5	25-50	39.0	9.618	24.7
Effigy	11	0.3	-	-	-	-	-
Miniatures	10	0.3	7	25-40	31.4	5.563	17.7
Pipe	1	-	-	-	-	-	-
Gourd jar	5	0.1	3	25-35	28.3	5.774	20.4
Unknown	25	0.7					
Total	3,811	100.0					

Diversity of Forms $H' = 1.029$
$s = 13$ $J = 0.401$

Table 2A.14. (continued)

6. Handles

Type	No.	%
Solid coil	10	2.6
Multi-coil	2	0.5
Strap	74	19.5
Tubular	9	2.4
Perforated tubular	2	0.5
Trough	242	63.9
Nubbin	3	0.8
Dual nubbin	1	0.3
Indented	2	0.5
Strap lug	17	4.5
Tabular lug	3	0.8
Cupule lug	2	0.5
Perforated nubbin lug	6	1.6
Multi-coil strap lug	2	0.5
Effigy	4	1.1
Total	379	100.0

Handles:items = 1:11
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
Sooting	14	0.4
None	3,667	96.4
Blackening	91	2.4
Fugitive red	20	0.5
Mineral encrustation	13	0.3
Total	3,805	100.0

Worked sherds = 534 (14.0%).

Table 2A.14. (continued)

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Pitcher	Canteen	Tecomate	Seed Jar	Gourd Jar	Olla	Other* Closed	Jar	Total
Hooks, flags	21	2	-	-	-	-	-	1	-	1	25
Nested isolates	14	1	1	-	-	-	-	-	-	3	19
Nonoverlapping steps	-	1	-	-	-	-	-	-	-	-	1
Parallel lines	330	24	8	1	-	1	1	12	5	81	463
Cribbed parallel lines	15	-	-	-	-	1	-	7	4	20	47
Pendant parallel lines	141	13	9	1	1	2	-	5	1	24	197
Framers with unticked solids	63	4	2	-	-	-	-	5	-	26	100
Framers with ticked solids	97	4	1	-	-	3	-	6	1	36	148
Irregular wide lines	1	-	-	-	1	-	-	-	-	-	2
Ticking	7	-	-	1	-	-	-	-	-	-	8
Corner triangles	20	4	-	-	-	-	-	-	-	2	26
Scrolls	338	77	20	4	4	7	2	11	5	51	519
Dots	7	1	-	-	-	1	-	-	3	5	17
Other framed isolates	1	-	1	-	-	-	-	-	-	-	2
Framing dots	11	-	-	-	-	-	-	1	-	5	17
Dotted lines	170	17	3	-	-	1	1	4	-	46	242
Thick wavy lines	26	4	-	1	-	1	-	-	-	5	37
Parallelograms	2	-	-	-	-	-	-	-	-	1	3
Checkerboard	234	12	3	2	-	5	-	2	3	7	268
Eyed solids	16	-	1	-	-	1	-	-	-	5	23
Sawteeth	150	20	4	1	3	4	-	6	5	34	227
Barbs	55	12	3	-	-	1	-	1	-	6	78
Elongated scalloped triangles	6	2	-	-	-	-	-	1	-	3	12
Wide Sosi style	8	-	1	-	-	-	-	1	-	2	12
Narrow Sosi style	28	3	-	-	1	2	-	1	-	3	38
Heavy dotted lines	9	5	-	-	-	-	-	1	-	1	16
Heavy curvilinear line	1	1	-	-	-	-	-	-	-	1	3
Solid band design	829	180	45	6	4	11	3	25	8	94	1,212
Hatched band motifs	5	-	-	-	-	-	-	2	-	-	7
Isolated triangles	3	-	-	-	-	-	-	1	-	1	5
General solids	239	16	7	1	-	3	-	5	1	32	304
Hachure A-1	208	35	7	2	-	4	-	4	4	43	307
	8	2	-	-	-	-	-	-	-	4	14

Table 2A.14. (continued)

Designs	Bowl	Ladle	Pitcher	Canteen	Tecomate	Seed Jar	Gourd Jar	Olla	Other* Closed	Jar	Total
Hachure A-2	12	4	-	-	-	1	-	2	1	2	22
Hachure A-3	8	-	1	-	-	1	-	-	-	2	12
Hachure B-1	10	1	-	-	-	-	-	1	-	-	12
Hachure B-2	1	2	-	-	-	-	-	-	-	1	4
Hachure B-3	3	-	-	-	-	-	-	-	-	-	3
Hachure B-4	1	-	-	-	-	-	-	1	-	-	2
Hachure B-5	1	-	-	-	-	-	-	-	-	-	1
Hachure B-6	2	-	-	-	-	-	-	1	-	-	3
Hachure B/C	8	2	-	-	-	-	-	-	-	4	14
Hatched checkerboard	5	-	-	-	-	-	-	-	-	-	5
Heavy Gallup squiggle	2	-	-	-	-	-	-	-	-	3	5
Squiggle lines	204	56	2	2	4	2	1	1	4	13	289
Interlocked frets	2	-	-	-	-	-		-	-	1	3
Anthro/zoomorphs	-	-	-	-	-	-	-	-	-	1	1
Solid ticked triangles	346	33	15	1	-	4	1	18	-	78	496
Bowl exterior motif	36	4	-	-	2	-	-	-	-	-	42
Jar neck motif	-	-	-	1	-	-	-	16	2	5	24
Narrow curvilinear	3	-	-	-	-	-	-	-	-	-	3
Interlocked ticking	98	13	4	2	-	1	1	1	1	13	134
Others, solid	11	1	-	-	-	-	-	-	-	1	13
Others, hachure	10	-	2	-	-	-	-	-	-	-	12
Banded, undifferentiated	3	-	-	-	-	-	-	-	-	-	3
Wide neckbanded	2	-	-	-	-	-	-	-	-	-	2
Narrow clapboard 2-5 mm	1	-	-	-	-	-	-	-	-	-	1
Wide clapboard >5 mm	1	-	-	-	-	-	-	--	-	-	1
Narrow corrugated 2-5 mm	1	-	-	-	-	-	-	--	-	1	2
Wide corrugated >5 mm	-	1	-	-	-	-	-	-	-	-	1
Total designs	3,827	555	140	26	20	57	10	143	48	662	5,448
% of designs	69.7	10.1	2.6	0.5	0.4	1.0	0.2	2.6	0.9	12.1	-
Total vessels	2,703	408	89	15	12	33	5	75	31	416	3,787
% of vessels	71.4	10.8	2.4	0.4	0.3	0.9	0.1	2.0	0.8	11.0	-

Table 2A.14. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=2,935, 82.2%)		
Fine to medium sandstone > sherd	774	21.7
Fine to medium sandstone < sherd	1,748	49.0
Coarse sandstone > sherd	130	3.6
Coarse sandstone < sherd	283	7.9
All chalcedonic sandstone*	330	9.2
Sandstone with rounded iron oxide	5	0.1
Magnetitic sandstone	11	0.3
Trachyte	31	0.9
Trachyte >sandstone	127	3.5
Sandstone >trachyte	23	0.6
San Juan igneous with hornblende	6	0.2
San Juan igneous with sandstone	10	0.3
Sandstone with San Juan igneous with hornblende	2	0.1
San Juan igneous without hornblende	4	0.1
San Juan igneous with sandstone	24	0.7
Sandstone with San Juan igneous without hornblende	11	0.3
Unidentified igneous	3	0.1
Unidentified with sandstone	33	0.9
Sandstone with unidentified igneous	13	0.4
Andesite with sandstone	1	-
Total	3,569	99.9

*Varieties specified: pink, n = 188.

Temper Diversity H' = 0.763
s = 17 J = 0.269

2. Texture Attributes

Grain Size	No.	%	Density	No.	%	Sherd Temper	No.	%
Fine	895	25.1	1-2%	23	0.8	None	368	10.3
Medium	2,193	61.5	5%	320	10.5	< half	921	25.8
Coarse	465	13.0	10%	1,133	37.3	> half	2,221	62.3
Very coarse	16	0.4	20%	1,247	41.1	All	58	1.6
Total	3,569	100.0	30%	272	9.0	Total	3,568	100.0
			>40%	38	1.3			
			Total	3,033	100.0			

Undifferentiated Sandstone Grain Size	No.	%
Fine	743	25.3
Medium	1,779	60.6
Coarse	401	13.7
Very coarse	12	0.4
Total	2,935	100.0

Texture Index	No.	%
Very fine (0-2)	716	23.6
Fine (2.1-4)	1,330	43.9
Fine-medium (4.1-7)	714	23.5
Medium (7.1-10)	170	5.6
Medium-coarse (10.1-13)	66	2.2
Coarse (13.1-16)	27	0.9
Very coarse (16.1+)	10	0.3
Total	3,033	100.0

Table 2A.14. (continued)

3. Clay Attributes

Clay-temper	No.	%
No type assigned	1,064	34.1
Black with white sherd	542	17.4
Gray with black sherd	470	15.1
Gray with black & white sherd	133	4.3
Gray with white sherd	699	22.4
"Little Colorado" gray	5	0.2
Chuska gray homogeneous	26	0.8
Tan to brown clay	39	1.3
Black clay	18	0.6
White clay	120	3.0
Total	3,116	100.0

Vitrification	No.	%
Absent	641	18.1
Present	864	24.3
Marked	2,046	57.6
Total	3,550	100.0

Paste Diversity $H' = 1.687$
$s = 10$ $J = 0.733$

Puerco Black-on-white

References: Toll and McKenna (1987)

Synonyms:

Chuska Mineral: Taylor Black-on-white (5.0 percent)
Degenerate Transitional (Roberts 1927)

Similar types:

Chuska Carbon: Toadlena Black-on-white
Mesa Verde: Mancos Black-on-white (1.7 percent)
Tusayan: Black Mesa and Sosi Black-on-whites

Production span: A.D. 1030 to 1200

Table: 2A.15

Description:

Puerco Black-on-white continues the use of many Red Mesa Black-on-white design elements, but the line widths tend to be wider and the execution bolder in Puerco Black-on-white. Use of band layouts continues, but "Sosi" layouts covering whole vessels are also common. Parallel lines, barbs, and solid triangles and scrolls also continue in use, although the use of ticking is generally replaced by scalloping on triangles. In this analysis the primary difference between Puerco and Escavada Black-on-whites is that Escavada Black-on-white is not polished; Escavada Black-on-white may also have hachured designs, whereas Puerco Black-on-white cannot. Late in Puerco Black-on-white's production span there are some well finished and painted specimens, sometimes with ticked rims that appear to be mineral-painted counterparts of Chaco McElmo Black-on-white, with which these specimens are contemporaneous. In this sample, dotted rims are only 2.5 percent of the observable rims.

The use of the type Puerco Black-on-white separates vessels with solid-painted elements from those with hachure-filled elements. Puerco and Gallup Black-on-whites, therefore, subdivide contemporaneous mineral-painted wares within the same series, like Sosi and Dogoszhi Black-on-whites in the Kayenta area, but unlike Mancos Black-on-white in the San Juan/Mesa Verde area and unlike Red Mesa Black-on-white of the preceding time period. Although Puerco Black-on-white is more abundant in some areas than Gallup Black-on-white, Gallup Black-on-white is always more common than Puerco Black-on-white in Chaco Canyon collections.

Compared to the Early Red Mesa and Red Mesa groups, Puerco Black-on-white bowls are much less likely to be slipped and polished on both sides, although distributions of slip and polish categories are similar for closed forms.

Table 2A.15. Puerco Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	-	-	-
Pueblo Alto	285	53.5	5.3
29SJ 423	-	-	-
29SJ 627	221	41.5	2.9
29SJ 628	-	-	-
29SJ 629	11	2.1	0.6
29SJ 633	3	0.6	0.9
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	13	2.4	0.6
Shabik'eshchee	-	-	-
Total	533	100.1	2.6

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	-	-	2	2	0.3
Nested isolates	2	-	-	2	0.3
Unnested isolates	-	1	1	2	0.3
Stars, suns	1	-	-	1	0.1
Nonoverlapping steps	-	-	1	1	0.1
Parallel lines	10	7	-	17	2.3
Cribbed parallel lines	2	2	-	4	0.5
Banded framers	2	-	-	2	0.3
Pendant parallel lines	14	9	-	23	3.1
Framers with unticked solids	-	1	-	1	0.1
Irregular wide lines	2	1	-	3	0.4
Ticking	-	2	2	4	0.5
Corner triangles	1	1	1	3	0.4
Scrolls	8	14	1	23	3.1
Framing dots	-	1	-	1	0.1
Dotted lines	1	7	2	10	1.3
Thick wavy lines	1	1	-	2	0.3
Parallelograms	5	1	-	6	0.8
Dots in parallelograms	-	-	1	1	0.1
Checkerboard	39	1	-	40	5.3
Eyed solids	6	4	1	11	1.5
Sawteeth	31	12	-	43	5.7
Barbs	68	20	3	91	12.1
Elongated scalloped triangles	18	2	1	21	2.8
Wide Sosi style	117	22	2	141	18.7
Heavy dotted lines	3	-	-	3	0.4
Heavy curvilinear lines	16	1	2	19	2.5
Narrow curvilinear lines	3	-	-	3	0.4
Solid band design	69	9	-	78	10.4
Hatched band design	1	-	1	2	0.3
Isolated triangles	4	5	-	9	1.2
General solids	44	24	-	68	9.0
Hachure A-3	1	-	-	1	0.1

Table 2A.15. (continued)

Designs	Motif No. 1	2	3	No.	%
Hachure B-7	-	1	-	1	0.1
Hatched checkerboard	1	1	1	3	0.4
Hatched pendants	1	-	-	1	0.1
Squiggle lines	-	1	-	1	0.1
Interlocked frets	-	-	1	1	0.1
Anthro/zoomorphs	2	-	-	2	0.3
Solid ticked traingles	32	9	1	42	5.6
Exterior bowl motif	1	11	5	17	2.3
Jar neck motif	3	4	1	8	1.1
Narrow Sosi style	21	3	-	24	3.2
Interlocked ticking	-	5	-	5	0.7
White exterior design	-	2	-	2	0.3
Others, hachure	-	3	1	4	0.5
Narrow corrugated 2-5 mm	-	-	1	1	0.1
Wide corrugated > 5 mm	-	-	1	1	0.1
Oblique corrugatd	1	-	-	1	0.1
Totals	531	189	33	753	100.0
No. with 1, 2, 3 treatments	342	156	33	531	-
% with 1, 2, 3 treatments	64.4	29.4	6.2	-	100.0

Type Design Diversity H' = 2.921
s = 49 J = 0.750
Design Distribution Diversity H' = 0.730
s = 3 J = 0.665

2. Paint

Type		No.	%
Mineral:	red	4	0.8
	brown	138	25.9
	green	6	1.1
	black	364	68.3
	glaze	18	3.4
Unknown		2	0.4
Total		532	100.0

Rim Decoration	No.	%
Unpainted	54	10.2
Solid line	274	51.5
Dotted	10	1.9
Eroded, solid line	17	3.2
Use-ground	42	7.9
Unknown	135	25.4
Total	532	100.1

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	10	2.5	-	-	10	1.9
None	34	8.4	4	3.3	38	7.2
One side						
Streaky	35	8.6	3	2.5	38	7.2
Moderate	75	18.4	29	23.8	104	19.7
Completely polished	178	43.7	86	70.5	264	49.9
Both sides						
Streaky	4	1.0	-	-	4	0.8
Moderate	16	3.9	-	-	16	3.0
Completely polished	21	5.2	-	-	21	4.0
Differential interior/exterior polish	34	8.4	-	-	34	6.4
Totals	407	76.9	122	23.1	529	100.1

*Unknown vessel forms omitted, n = 3.

Table 2A.15. (continued)

4. Slip*

	Open		Closed		Total	
Type	No	%	No.	%	No.	%
Absent	28	6.9	5	4.1	33	6.2
Interior	178	43.7	-	-	178	33.6
Exterior	-	-	97	79.5	97	18.3
Slipslop	68	16.7	19	15.6	87	16.5
Both sides	121	29.7	1	0.8	122	23.1
Unknown	12	3.0	-	-	12	2.3
Totals	407	76.9	122	23.1	529	100.0

*Unknown vessels forms omitted, n = 3.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	330	61.9	272	60-350	205.5	65.554	31.9
Ladle	78	14.6	35	65-220	103.9	33.279	32.0
Jar	74	13.9	9	50-120	77.8	21.376	27.5
Olla	15	2.8	8	70- 90	78.8	8.345	10.6
Pitcher	20	3.8	16	40-115	80.3	19.015	23.7
Seed jar	3	0.6	2	70-110	90.0	28.284	31.4
Tecomate	2	0.4	2	35-70	52.5	24.749	47.1
Canteen	5	0.9	5	20-30	27.0	4.472	16.6
Effigy	2	0.4	-	-	-	-	-
Mug/cup	1	0.2	1	80	-	-	-
Unknown	3	0.6	-	-	-	-	-
Total	533	100.1	-	-	-	-	-

Diversity of Forms H' = 1.204
s = 10 J = 0.523

6. Handles

Type	No.	%
Solid coil	3	4.5
Strap	5	7.6
Tubular	13	19.7
Perforated tubular	2	3.0
Trough	32	48.5
Nubbin	1	1.5
Strap lug	5	7.6
Perforated nubbin lug	3	4.5
Effigy	2	3.0
Total	66	99.9

Handles:items = 1:8
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	499	94.0
Blackening	15	2.8
Fugitive red	5	0.9
Mineral encrustation	12	2.3
Total	531	

Worked sherds = 26 (4.9%).

Table 2A.15. (continued)

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Canteen	Pitcher	Tecomate	Seed Jar	Mug	Effigy	Olla	Jar	Total
Hooks, flags	1	-	-	-	-	-	-	-	-	1	2
Nested isolates	1	-	-	-	-	-	-	-	-	1	2
Unnested isolates	-	-	1	-	-	-	-	-	-	1	2
Stars, suns	1	-	-	-	-	-	-	-	-	-	1
Nonoverlapping steps	1	-	-	-	-	-	-	-	-	-	1
Parallel lines	9	3	-	-	-	-	-	-	-	5	17
Cribbed parallel lines	2	1	-	-	-	-	-	-	-	1	4
Banded framers	2	-	-	-	-	-	-	-	-	1	3
Pendant parallel lines	17	4	1	-	-	-	-	-	-	1	23
Framers with unticked solid	1	-	-	-	-	-	-	-	-	-	1
Irregular wide lines	-	2	-	-	-	-	-	-	-	1	3
Ticking	4	-	-	-	-	-	-	-	-	-	4
Corner triangles	2	-	-	-	-	-	-	-	-	1	3
Scrolls	10	3	-	2	-	-	-	-	-	8	23
Framing dots	1	-	-	-	-	-	-	-	-	-	1
Dotted lines	7	1	-	-	-	-	-	-	-	2	10
Thick wavy lines	-	1	-	1	-	-	-	-	-	-	2
Parallelograms	4	-	-	-	1	-	-	-	-	1	6
Dots in parallelograms	-	-	-	1	-	-	-	-	-	-	1
Checkerboard	25	-	1	-	-	2	-	-	1	4	39
Eyed solids	6	-	-	-	-	-	-	-	1	4	11
Sawteeth	25	-	1	-	-	-	-	-	-	7	42
Barbs	51	-	2	4	-	-	-	-	5	15	91
Elongated scalloped triangle	16	-	-	2	-	-	1	-	1	1	21
Wide Sosi style	86	-	1	8	-	1	-	1	7	21	141
Heavy dotted lines	3	-	-	-	-	-	-	-	-	-	3
Heavy curvilinear lines	14	-	-	1	-	-	-	1	-	2	19
Solid band design	53	-	1	2	-	-	-	-	5	4	78
Hatched band motifs	2	-	-	-	-	-	-	-	-	-	2
Isolated traingles	8	-	-	-	-	-	-	-	-	1	9
General solids	45	-	-	2	-	-	-	-	3	11	67
Hachure A-3	1	-	-	-	-	-	-	-	-	-	1

Table 2A.15. (continued)

Designs	Bowl	Ladle	Canteen	Pitcher	Tecomate	Seed Jar	Mug	Effigy	Olla	Jar	Total
Hachure B-7	-	1	-	-	-	-	-	-	-	-	1
Hatched checkerboard	2	-	-	-	-	-	-	-	-	1	3
Hatched pendants	-	1	-	-	-	-	-	-	-	-	1
Squiggle lines	1	-	-	-	-	-	-	-	-	-	1
Interlocked frets	-	-	-	-	-	-	-	-	-	1	1
Anthro/zoomorphs	1	-	-	-	-	-	-	-	-	-	1
Solid ticked triangles	23	-	-	2	1	-	-	-	1	10	42
Bowl exterior motif	16	1	-	-	-	-	-	-	-	-	17
Jar neck motif	-	-	2	1	-	-	-	-	3	2	8
White exterior design	2	-	-	-	-	-	-	-	-	-	2
Narrow Sosi style	18	4	1	-	-	-	-	-	-	1	24
Narrow cuvilinear	-	2	-	1	-	-	-	-	-	-	3
Interlocked ticking	4	-	-	1	-	-	-	-	-	-	5
Others, hachure	4	-	-	-	-	-	-	-	-	-	4
Narrow corrugated 2-5 mm	1	-	-	-	-	-	-	-	-	-	1
Wide corrugated 5 mm	1	-	-	-	-	-	-	-	-	-	1
Oblique corrugated	1	-	-	-	-	-	-	-	-	-	1
Total design	472	94	11	28	2	3	1	2	27	110	750
% of design	62.9	12.5	1.5	3.7	0.3	0.4	0.1	0.3	3.6	14.7	-
Total vessels	330	78	5	20	2	3	1	2	15	74	530
% of vessels	62.3	14.7	0.9	3.8	0.4	0.6	0.2	0.4	2.8	14.0	-

Table 2A.15. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=384, 83.8%)		
Fine to medium sandstone > sherd	58	12.7
Fine to medium sandstone < sherd	218	47.6
Coarse sandstone > sherd	24	5.2
Coarse sandstone < sherd	84	18.3
All chalcedonic sandstone*	11	2.4
Magnetitic sandstone	1	0.2
Trachyte	10	2.2
Trachyte > sandstone	13	2.8
Sandstone > trachyte	20	4.4
San Juan igneous with hornblende and sandstone	3	0.7
San Juan igneous without hornblende	2	0.4
San Juan igneous with sandstone	3	0.7
Sandstone with San Juan igneous without hornblende	2	0.4
Unidentified igneous	1	0.2
Unidentified with sandstone	1	0.2
Sandstone with unidentified igneous	6	1.3
Shale	1	0.2
Total	458	99.9

*Varieties specified: Pink n = 8

Temper Diversity $H' = 0.782$
$s = 14$ $J = 0.296$

2. Texture Attributes

Grain Size	No.	%
Fine	78	17.0
Medium	263	57.4
Coarse	114	24.9
Very coarse	3	0.7
Total	458	100.0

Density	No.	%
1-2%	9	2.2
5%	89	21.8
10%	180	44.0
20%	111	27.1
30%	16	3.9
>40%	4	1.0
Total	409	100.0

Sherd Temper	No.	%
None	28	6.1
< half	102	22.3
> half	299	65.3
All	29	6.3
Total	458	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	58	15.1
Medium	218	56.8
Coarse	105	27.3
Very coarse	3	0.8
Total	384	100.0

Texture Index	No.	%
Very fine (0-2)	96	23.5
Fine (2.1-4)	176	43.0
Fine-medium (4.1-7)	106	25.9
Medium (7.1-10)	24	5.9
Medium-coarse (10.1-13)	3	0.7
Coarse (13.1-16)	3	0.7
Very coarse (16.1+)	1	0.2
Total	409	99.9

Table 2A.15. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	126	30.4
Black with white sherd	53	12.8
Gray with black sherd	56	13.5
Gray with black and white	43	10.3
Gray with white sherd	98	23.6
Chuska gray homogeneous	3	0.7
Tan to brown clay	9	2.2
Black clay	1	0.2
White clay	26	6.3
Total	415	100.1

Vitrification	No.	%
Absent	98	21.4
Present	162	35.5
Marked	197	43.1
Total	457	100.0

Paste Diversity $H' = 1.778$
$s = 9$ $J = 0.809$

Escavada Black-on-white

References: Hawley (1936); Vivian (1959); Windes (1984b)

Synonyms:

Chuska Mineral: Taylor Black-on-white (1.3 percent)
Degenerate Transitional (Roberts 1927)
Mesa Verde: Mancos Black-on-white (1.3 percent)

Similar types:

Chuska Carbon: Toadlena Black-on-white
Tusayan: Black Mesa Black-on-white

Production span: A.D. 1000 to 1100 (estimated)

Table: 2A.16

Description:

The type names Escavada and Puerco Black-on-white have complex and confusing histories, and many schemes have been used to separate or combine them (Reed 1993). The primary criterion for identification of Escavada Black-on-white in this analysis is its rough, unpolished surface finish and coarse-grained temper rather than its design. This coarser temper and lack of polish contribute to Roberts' (1927) calling ceramics from this time period "degenerate." Considerably less slip is also present on Escavada Black-on-white sherds. Using these criteria, Puerco Black-on-white is two to three times more abundant than Escavada Black-on-white. In classification of sherds, hatched fillers were somewhat more likely to be placed in Escavada Black-on-white than in Puerco Black-on-white (4.7 percent as opposed to 1.1 percent of total elements), although most hatched cases were placed in Gallup Black-on-white (82.1 percent of total elements), regardless of finish. The plates and description in Vivian (1959:20-21) are in accord with the classifications made in this analysis, except that the long production span he assigns this type indicate that he probably included some items that would have been called Red Mesa Black-on-white here. Windes' impression is that this type is likely to have been made mostly toward the end of the Red Mesa production span.

The high percentage of bowls and scarcity of closed forms in Escavada Black-on-white is similar to the Red Mesa Black-on-white vessel form distribution.

Table 2A.16. Escavada Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	
29SJ 299 PI	1	0.5	0.4
Pueblo Alto	142	67.0	2.6
29SJ 423	-	-	-
29SJ 627	53	25.0	0.7
29SJ 628	-	-	-
29SJ 629	3	1.4	0.2
29SJ 633	5	2.4	1.6
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	8	3.8	0.4
Shabik'eshchee	-	-	-
Total	212	100.1	1.1

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	-	1	-	1	0.3
Nested isolated	-	1	-	1	0.3
Unnested isolates	-	-	1	1	0.3
Stars, suns	1	-	1	2	0.6
Parallel lines	10	2	-	12	3.7
Cribbed parallel lines	1	-	-	1	0.3
Pendant parallel lines	11	3	-	14	4.4
Framers with unticked solids	1	-	-	1	0.3
Framers with ticked solids	-	1	-	1	0.3
Irregular wide lines	3	1	-	4	1.2
Ticking	-	2	2	4	1.2
Corner triangles	1	3	-	4	1.2
Scrolls	5	11	2	18	5.6
Dots	1	-	-	1	0.3
Linear dots	1	-	-	1	0.3
Dotted lines	2	5	-	7	2.2
Thick wavy lines	-	1	-	1	0.3
Parallelograms	2	-	-	2	0.6
Checkerboard	23	1	-	24	7.5
Eyed solids	1	1	2	4	1.2
Sawteeth	14	5	-	19	5.9
Barbs	21	7	1	29	9.0
Elongated scalloped triangles	2	4	-	6	1.9
Wide Sosi style	33	6	2	41	12.7
Narrow Sosi style	10	-	1	11	3.4
Heavy dotted lines	1	1	-	2	0.6
Heavy curvilinear lines	12	2	-	14	4.4
Narrow curvilinear lines	1	-	-	1	0.3
Solid band designs	26	4	-	30	9.3
Hatched band design	2	1	-	3	0.9
Isolated triangles	1	-	-	1	0.3

Table 2A.16. (continued)

Designs	Motif No. 1	2	3	No.	%
General solids	14	9	-	23	7.1
Hachure A-3	3	-	-	3	0.9
Hachure B-1	2	2	1	5	1.6
Hachure B-2	2	-	-	2	0.6
Hachure B-3	-	2	-	2	0.6
Hachure B-6	2	-	-	2	0.6
Others, hachure	1	2	-	3	0.9
Interlocked frets	-	1	1	2	0.6
Anthro/zoomorphs	-	1	-	1	0.3
Solid ticked triangles	2	3	1	6	0.9
Exterior bowl motif	-	2	-	2	0.6
Jar neck motif	-	2	1	3	0.9
White exterior design	-	-	1	1	0.3
Interlocked ticking	-	-	2	2	0.6
Others, solid	-	-	1	1	0.3
Narrow corrugated 2-5 mm	-	-	1	1	0.3
Wide corrugated > 5 mm	-	1	-	1	0.3
Totals	212	90	20	322	99.5
No. with 1, 2, 3 treatments	122	70	20	212	-
% with 1, 2, 3 treatments	57.6	33.0	9.4	-	100.0

Type Design Diversity $H' = 3.195$
$s = 48$ $J = 0.825$
Design Distribution Diversity $H' = 0.804$
$s = 3$ $J = 0.732$

2. Paint

Type		No.	%
Mineral:	red	3	1.4
	brown	65	20.8
	green	3	0.7
	black	138	75.7
	glaze	3	1.1
Total		212	100.0

Rim Decoration	No.	%
Unpainted	36	17.0
Solid line	123	58.0
Dotted	3	1.4
Eroded, solid line	10	4.7
Use-ground	12	5.7
Unknown	28	13.2
Total	212	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	6	3.4	2	5.9	8	3.8
None	83	46.6	16	47.1	99	46.7
One side						
Streaky	26	14.6	3	8.8	29	13.7
Moderate	29	16.3	6	17.6	35	16.5
Completely polished	19	10.7	7	20.6	26	12.3
Both sides						
Streaky	5	2.8	-	-	5	2.4
Moderate	2	1.1	-	-	2	0.9
Completely polished	1	0.6	-	-	1	0.5
Differential interior/exterior polish	7	3.9	-	-	7	3.3
Totals	178	84.0	34	16.0	212	100.1

Table 2A.16. (continued)

4. Slip

	Open		Closed		Total	
Location	No.	%	No.	%	No.	%
Absent	47	26.4	9	26.5	56	25.4
Interior	64	36.0	-	-	64	30.2
Exterior	-	-	15	44.1	15	7.2
Slipslop	34	19.1	10	29.4	44	20.8
Both sides	29	16.3	-	-	29	13.7
Unknown	4	2.2	-	-	4	1.9
Totals	178	84.0	34	16.0	212	100.1

5. Forms and Metrics

			Orifice Diameter				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	155	73.1	129	60-350	209.5	70.260	33.5
Ladle	23	10.8	15	60-145	97.0	24.626	25.4
Jar	10	4.7	1	60	-	-	-
Olla	5	2.4	3	70- 90	80.0	10.000	12.5
Pitcher	13	6.1	12	10- 95	74.2	24.105	32.5
Seed jar	4	1.9	4	50-130	95.0	36.968	38.9
Tecomate	1	0.5	-	-	-	-	-
Effigy	1	0.5	-	-	-	-	-
Total	212	100.0	-	-	-	-	-

Diversity of Forms H' = 1.000
s = 8 J = 0.480

6. Handles

Type	No.	%
Solid coil	2	8.3
Strap	2	8.3
Tubular	4	16.7
Trough	10	41.7
Nubbin	1	4.2
Indented	1	4.2
Strap lug	3	12.5
Sagging nubbins	1	4.2
Total	24	100.1

Handles:items = 1:11
(excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	205	96.7
Blackening	6	2.8
Mineral	1	0.5
Total	212	100.0

Worked sherds = 7 (3.3%).

Table 2A.16. (continued)

8. Designs by Vessel Form

Designs	Bowl	Ladle	Pitcher	Tecomate	Seed Jar	Effigy	Olla	Jar	Total
Hooks, flags	-	-	-	-	-	-	-	1	1
Nested isolates	1	-	-	-	-	-	-	-	1
Unnested isolates	-	-	-	-	-	-	-	1	1
Stars, suns	1	-	1	-	-	-	-	-	2
Parallel lines	8	1	1	-	1	-	-	1	12
Cribbed parallel lines	1	-	-	-	-	-	-	-	1
Pendant parallel lines	9	3	-	-	-	-	-	2	14
Framers with unticked solids	1	-	-	-	-	-	-	-	1
Framers with ticked solids	1	-	-	-	-	-	-	-	1
Irregular wide lines	2	-	1	-	1	-	-	-	4
Ticking	2	2	-	-	-	-	-	-	4
Corner triangles	2	2	-	-	-	-	-	-	4
Scrolls	9	4	4	-	-	-	-	1	18
Dots	-	1	-	-	-	-	-	-	1
Linear dots	-	1	-	-	-	-	-	-	1
Dotted lines	6	1	-	-	-	-	-	-	7
Thick wavy lines	1	-	-	-	-	-	-	-	1
Parallelograms	2	-	-	-	-	-	-	-	2
Checkerboard	17	5	-	-	1	-	1	-	24
Eyed solids	3	-	-	-	-	-	-	1	4
Sawteeth	9	2	3	-	2	1	-	2	19
Barbs	24	1	1	-	-	-	2	1	29
Elongated scalloped triangles	2	-	2	-	-	-	2	-	6
Wide Sosi style	32	2	2	-	-	-	2	3	41
Narrow Sosi style	8	1	2	-	-	-	-	-	11
Heavy dotted lines	2	-	-	-	-	-	-	-	2
Heavy curvilinear line	11	-	1	1	-	-	-	1	14
Narrow curvilinear lines	-	-	1	-	-	-	-	-	1
Solid band design	18	6	3	-	-	-	1	2	30
Hatched band design	3	-	-	-	-	-	-	-	3
Isolated triangles	1	-	-	-	-	-	-	-	1
Undifferentiated solid	20	-	2	-	-	-	-	1	23

Table 2A.16. (continued)

Designs	Bowl	Ladle	Pitcher	Tecomate	Seed Jar	Effigy	Olla	Jar	Total
Hachure A-3	3	-	-	-	-	-	-	-	3
Hachure B-1	3	-	1	-	-	-	1	-	5
Hachure B-2	2	-	-	-	-	-	-	-	2
Hachure B-3	2	-	-	-	-	-	-	-	2
Hachure B-6	2	-	-	-	-	-	-	-	2
Other hachure	3	-	-	-	-	-	-	-	3
Interlocked frets	1	-	-	-	-	-	-	1	2
Anthro/zoomorphs	1	-	-	-	-	-	-	-	1
Solid ticked triangles	6	-	-	-	-	-	-	-	6
Exterior bowl motif	2	-	-	-	-	-	-	-	2
Jar neck motif	-	-	-	-	-	-	2	1	3
White exterior design	1	-	-	-	-	-	—	-	1
Interlocked ticking	-	2	-	-	-	-	-	-	2
Other solids	2	-	-	-	-	-	-	-	2
Narrow corrugated 2-5 mm	1	-	-	-	-	-	-	-	1
Wide corrugated >5 mm	1	-	-	-	-	-	-	-	1
Totals	226	34	25	1	5	1	11	19	322

Table 2A.16. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=140, 89.2%)		
Fine to medium sandstone > sherd	14	8.9
Fine to medium sandstone < sherd	49	31.2
Coarse sandstone > sherd	23	14.6
Coarse sandstone < sherd	54	34.4
All chalcedonic sandstone*	7	4.5
Magnetitic sandstone	2	1.3
Trachyte	1	0.6
Trachyte > sandstone	1	0.6
Sandstone > trachyte	4	2.6
San Juan igneous with hornblende + sandstone	1	0.6
San Juan igneous without hornblende + sandstone	1	0.6
Total	157	100.0

*Varieties specified; pink, n = 3.

Temper Diversity H' = 0.519
s = 8 J = 0.249

2. Texture Attributes

Grain Size	No.	%
Fine	13	8.3
Medium	60	38.2
Coarse	76	48.4
Very coarse	8	5.1
Total	157	100.0

Density	No.	%
1-2%	6	4.2
5%	40	28.0
10%	69	48.3
20%	24	16.8
30%	4	2.8
Total	143	100.0

Sherd Temper	No.	%
None	20	12.7
< half	25	15.9
> half	101	64.3
All	11	7.0
Total	157	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	10	7.1
Medium	53	37.9
Coarse	70	50.0
Very coarse	7	5.0
Total	140	100.0

Texture Index	No.	%
Very fine (0-2)	24	16.8
Fine (2.1-4)	51	35.7
Fine-medium (4.1-7)	48	33.6
Medium (7.1-10)	6	4.2
Medium-coarse (10.1-13)	3	2.1
Coarse (13.1-16)	7	4.9
Very coarse (16.1+)	4	2.8
Total	143	100.1

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	51	35.4
Black with white sherd	11	7.6
Gray with black sherd	12	8.3
Gray with black & white	20	13.9
Gray with white sherd	35	24.3
Tan to brown clay	6	4.2
Black clay	1	0.7
White clay	8	5.6
Total	144	100.0

Vitrification	No.	%
Absent	30	19.2
Present	69	44.2
Marked	57	36.5
Total	156	100.0

Paste Diversity H' = 1.717
s = 8 J = 0.826

Gallup Black-on-white

References: Colton (1953); Toll and McKenna (1987); Windes (1977:344-345)

Synonyms:

Chuska Mineral: Brimhall Black-on-white (19.5 percent)
Hachure B (Roberts 1927)

Similar types:

Chuska Carbon: Burnham, Chuska Black-on-whites
Mesa Verde: Mancos Black-on-white (0.7 percent)
Tusayan: Dogoszhi Black-on-white

Production span: A.D. 1040 to 1150

Table: 2A.17

Description:

After Red Mesa Black-on-white, Gallup Black-on-white is the second most abundant specific type in the Chaco Project collection, and the most common in the Pueblo Alto collection. The type is defined mostly by the presence of hachure. The hachure lines are usually at an angle to the framing lines, and are more closely spaced than hachure in Red Mesa Black-on-white. Generally, the framing lines are wider than the hachure lines, but this is not always so, or necessary to assignment of the type. In Chaco Canyon at least, equal framer and hachure lines generally are earlier, and the trend is toward heavier and heavier framers, culminating (decoratively if not developmentally) in Chaco Black-on-white. Unlike Goetze and Mills' (1993:30-35) approach, which requires framing lines and hachure lines to be equal in width, the majority of sherds included in Gallup Black-on-white here have wider framing lines than hachure lines. The four most abundant hachure types, B-4, B-1, B-3, and B/C account for 58 percent of the design codes. B-4 has relatively heavy framers and closely spaced hachure; B-1 has less heavy framers and less dense hachure but still good execution; B-3 is characterized by some hachures that fall outside the framers; and B/C has heavy framers and closely spaced, finely squiggled hachures (Figure 2.3).

The most common element shape is triangular pennants; early examples of this shape and filler may be recognized by the tip of the pennant sometimes being filled in (painted solid). Another temporal trend is for there to be less difference in framer-hachure line width in earlier examples, although this may also have some spatial basis, with less framer emphasis further south of Chaco Canyon; this possibility needs more study. Scrolls, continuous framers, and rectangular elements also occur.

Through time, design fields in Gallup Black-on-white became increasingly filled, making use of what Jernigan (1986:27) calls counterchange designs, where shapes left by unpainted areas are the same as those that are painted. In this analysis, "counterchange" was recorded as reflective hatched and solid designs characteristic of Reserve Black-on-white but rare in this assemblage (0.9 percent).

The frequency of closed forms in Gallup Black-on-white is around a third, which is considerably more than in Red Mesa Black-on-white where it is less than 20 percent. Closed forms, however, constitute more than half of whole vessel assemblages (Windes and McKenna 1989:40). Ladles are relatively less common in Gallup Black-on-white, and pitchers relatively more abundant.

Figures: Early Gallup examples in Figures 2A.13, 2A.14, and 2A.15

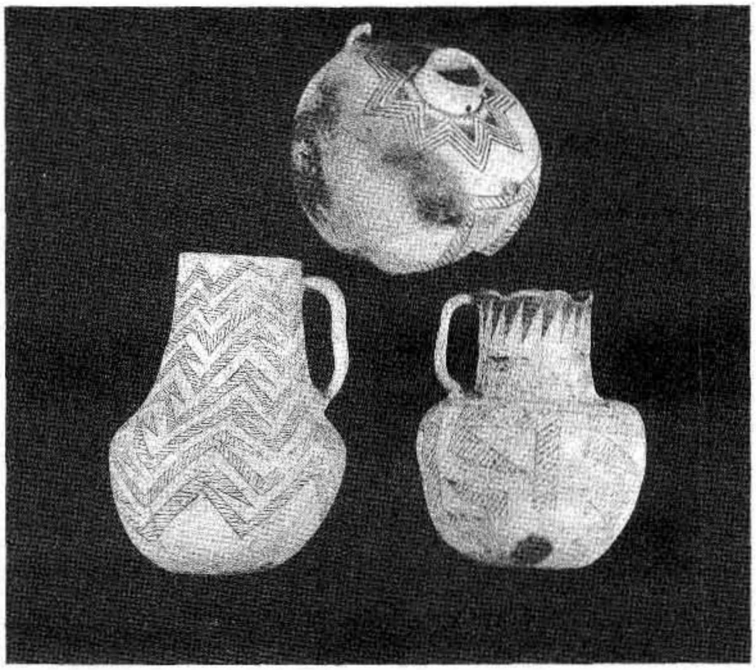


Figure 2A.13. *Vessels from 29SJ 629 (canteen) and 29SJ 1360 (pitcher) showing designs transitional between Red Mesa and early Gallup Black-on-white. Note the equal and nearly equal widths of framing and hachure lines and the helical and band design deployments. (NPS Chaco Archive Negative No. 23162).*

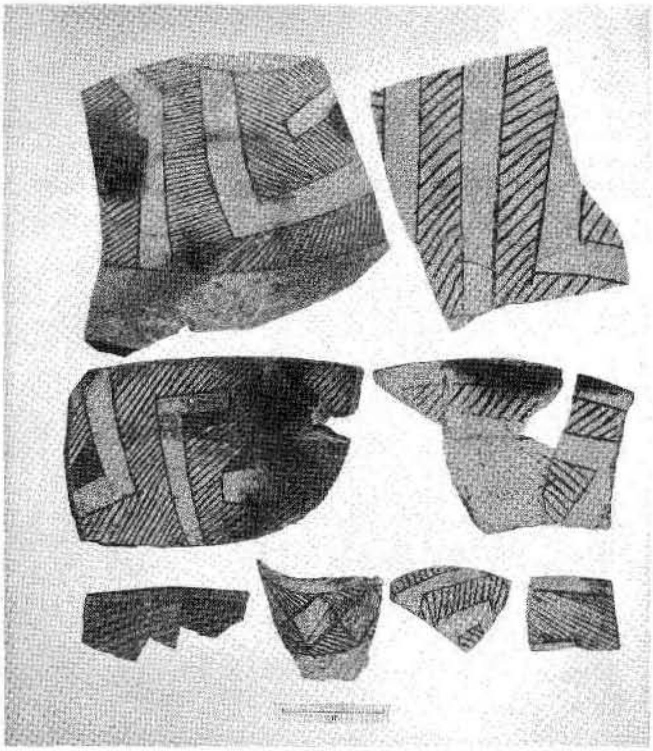


Figure 2A.14. *Early Gallup Black-on-white sherds from 29SJ 629. Several attributes of early Gallup Black-on-white are visible: framers and hatch lines are close in width and a corner of one of the hatched areas is painted solid. As in both Red Mesa Black-on-white and later Gallup Black-on-white, there is also some squiggle hachure. (NPS Chaco Archive Negative No. 31954).*

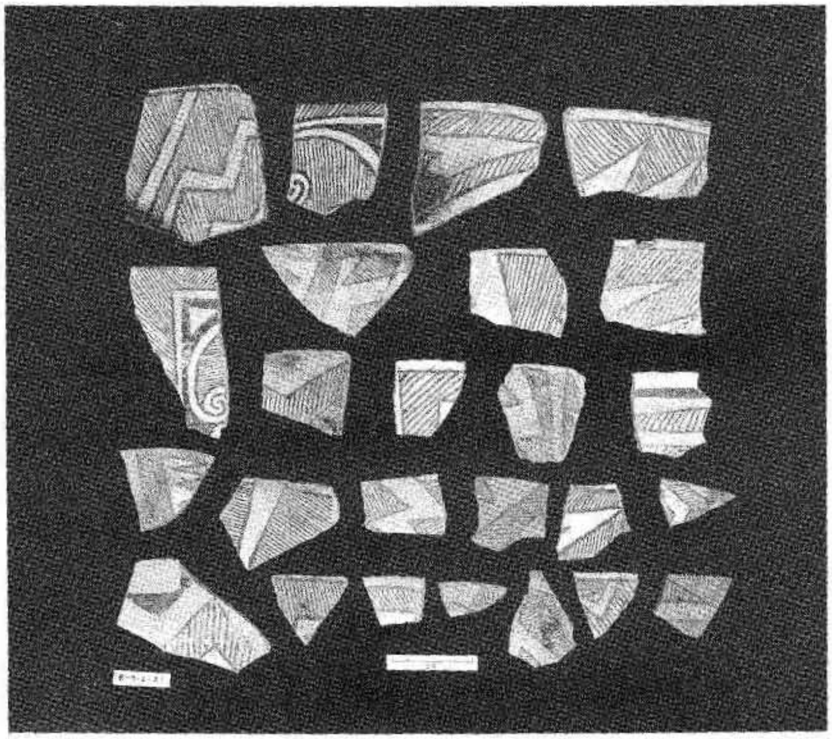


Figure 2A.15. *Gallup Black-on-white sherds from the Pueblo Alto Trash Mound. (NPS Chaco Archive Negative No. 23165).*

Table 2A.17. Gallup Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	5	0.3	2.0
Pueblo Alto	1,043	62.4	19.4
29SJ 423	-	-	-
29SJ 627	551	33.0	7.3
29SJ 628	1	0.1	0.1
29SJ 629	22	1.3	1.3
29SJ 633	14	0.8	4.4
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	36	2.2	1.7
Shabik'eshchee	-	-	-
Total	1,672	100.1	8.3

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Isolated single elements	-	-	1	1	0.1
Hooks, flags	-	-	1	1	0.1
Unnested isolates	-	1	-	1	0.1
Parallel lines	4	3	-	7	0.3
Cribbed parallel lines	1	-	-	1	0.1
Pendant parallel lines	5	-	-	5	0.2
Framers with ticked solids	-	1	-	1	0.1
Irregular wide lines	1	-	-	1	0.1
Ticking	-	-	1	1	0.1
Corner triangles	-	51	9	60	2.9
Scrolls	-	5	-	5	0.2
Dots	-	1	-	1	0.1
Dotted lines	-	4	1	5	0.2
Parallelograms	1	-	-	1	0.1
Checkerboard	2	2	-	4	0.2
Eyed solids	1	4	1	6	0.3
Sawteeth	-	5	1	6	0.3
Barbs	1	14	1	16	0.8
Elongated scalloped triangles	2	5	1	7	0.3
Wide Sosi style	9	13	1	23	1.1
Narrow Sosi style	1	2	-	3	0.1
Heavy curvilinear lines	1	16	2	19	0.9
Narrow curvilinear	-	2	-	2	0.1
Hatched band design	26	14	1	41	2.0
Isolated triangles	2	4	-	6	0.3
General solids	7	46	1	54	2.6
Hachure A-1	9	-	-	9	0.4
Hachure A-2	22	4	-	26	1.2
Hachure A-3	36	2	-	38	1.8

Table 2A.17. (continued)

	Motif No.				
Designs	1	2	3	No.	%
Hachure B-1	328	21	3	352	16.9
Hachure B-2	8	1	-	9	0.4
Hachure B-3	232	5	-	237	11.4
Hachure B-4	426	18	1	445	21.4
Hachure B-5	6	-	1	7	0.3
Hachure B-6	97	14	-	111	5.3
Hachure B-7	13	4	-	17	0.8
Hachure B/C	156	9	-	165	7.9
Hachure C	42	-	-	42	2.0
Counterchange	16	2	-	18	0.9
Hatched checkerboard	58	11	1	70	3.4
Heavy Gallup squiggle	27	-	-	27	1.3
Hatched pendants	5	5	-	10	0.5
Anthro/zoomorphs	-	1	-	1	0.1
Solid ticked triangles	-	13	1	14	0.7
Exterior bowl motif	1	26	4	31	1.5
Jar neck motif	5	15	2	22	1.1
Others, solid	4	10	-	14	0.7
Others, hachure	113	9	-	122	5.9
Narrow clapboard 2-5 mm	-	2	-	2	0.1
Narrow corrugated 2-5 mm	1	1	1	3	0.1
Wide corrugted > 5 mm	-	2	1	3	0.1
Undifferentiated corrugated	-	1	-	1	0.1
Totals	1,169	373	39	2,081	100.3
No. with 1, 2, 3 treatments	1,296	334	39	1,669	-
% with 1, 2, 3 treatments	77.7	20.0	2.3	-	100.0

Type Design Diversity H' = 2.781
s = 54 J = 0.697
Design Distribution Diversity H' = 0.560
s = 3 J = 0.509

2. Paint

Type		No.	%
Mineral:	red	50	3.0
	brown	435	26.1
	green	27	1.6
	black	1,107	66.2
	glaze	46	2.8
Mineral-carbon		2	0.1
Unknown		4	0.2
Total		1,671	100.0

Rim Decoration	No.	%
Unpainted	153	9.2
Solid line	870	52.1
Dotted	17	1.0
Eroded, solid line	58	3.5
Use-ground	74	4.4
Unknown	499	29.9
Total	1,671	100.1

Table 2A.17. (continued)

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	69	6.4	26	4.4	95	5.7
None	103	9.5	36	6.2	139	8.3
One side						
Streaky	59	5.5	25	4.3	84	5.0
Moderate	112	10.4	60	10.3	172	10.3
Completely polished	561	51.8	438	74.9	999	59.9
Both sides						
Streaky	8	0.7	-	-	8	0.5
Moderate	13	1.2	-	-	13	0.8
Completely polished	72	6.7	-	-	72	4.3
Differential interior/exterior polish	85	7.9	-	-	85	5.1
Totals	1,082	64.9	585	35.1	1,667	99.9

*Unknown forms excluded, n = 4.

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	100	9.4	32	5.5	132	8.0
Interior	466	43.7	-	-	466	28.3
Exterior	-	-	438	75.8	438	26.6
Slipslop	218	20.4	96	16.6	314	19.1
Both sides	233	21.8	-	-	233	14.2
Unknown	50	4.7	12	2.1	62	3.8
Totals	1,067	64.9	578	35.1	1,645	100.0

* Unknown forms excluded, n = 4.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	983	58.9	732	50-360	214.5	64.962	30.3
Ladle	100	6.0	63	60-240	124.4	32.410	26.1
Jar	330	19.8	19	40-140	77.4	23.415	30.3
Pitcher	154	9.2	129	30-180	90.2	23.175	25.7
Olla	49	2.9	29	50-110	77.9	14.548	18.7
Canteen	8	0.5	6	20-40	33.3	8.165	24.5
Seed jar	18	1.1	12	55-190	122.1	38.462	31.5
Tecomate	15	0.9	12	40-190	109.2	46.015	42.2
Duck pot	2	0.1					
Effigy	1	0.1					
Miniatures	7	0.4					
Cylinder	1	0.1					
Unknown	2	0.1					
Total	1,670	100.1					

Diversity of Forms $H' = 1.281$
$s = 12$ $J = 0.516$

Table 2A.17. (continued)

6. Handles

Type	No.	%
Solid coil	3	2.3
Multi-coil	1	0.8
Strap	41	31.8
Tubular	16	12.4
Perforated tubular	2	1.5
Trough	26	20.1
Nubbin	1	0.8
Indented	5	3.9
Strap lug	18	14.0
Tabular lug	5	3.9
Perforated nubbin lug	6	4.6
Multi-coil strap lug	5	3.9
Total	129	100.0

Handles:items = 1:13
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	1,594	95.4
Blackening	23	1.4
Fugitive red	11	0.7
Mineral incrustation	43	2.6
Total	1,671	100.1

Worked sherds = 125 (7.5% of total).

Table 2A.17. *(continued)*

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Canteen	Pitcher	Tecomate	Seed Jar	Duck Pot	Miniature Effigy	Cylinder Jar	Olla	Jar	Totals
Isolated single elements	1	-	-	-	-	-	-	-	-	-	-	1
Hooks, flags	-	-	-	-	-	-	-	-	-	1	-	1
Unnested isolates	1	-	-	-	-	-	-	-	-	-	-	1
Parallel lines	6	1	-	-	-	-	-	-	-	-	-	7
Cribbed parallel lines	1	-	-	-	-	-	-	-	-	-	-	1
Pendant parallel lines	4	-	-	-	-	-	-	-	-	-	1	5
Framers with ticked solids	-	-	1	-	-	-	-	-	-	-	-	1
Irregular wide lines	1	-	-	-	-	-	-	-	-	-	-	1
Ticking	1	-	-	-	-	-	-	-	-	-	-	1
Corner triangles	34	2	-	4	1	-	1	-	1	2	15	60
Scrolls	5	-	-	-	-	-	-	-	-	-	-	5
Dots	-	-	-	-	-	-	1	-	-	-	-	1
Dotted lines	4	-	-	-	-	-	-	-	-	-	1	5
Parallelograms	-	-	-	1	-	-	-	-	-	-	-	1
Checkerboard	3	1	-	-	-	-	-	-	-	-	-	4
Eyed solids	3	-	-	2	-	-	-	-	-	-	1	6
Sawteeth	2	-	-	1	-	-	-	-	-	1	2	6
Barbs	10	1	-	1	-	-	1	--	-	-	3	16
Elongated scalloped triangles	1	-	-	1	-	-	-	-	-	1	4	7
Wide Sosi style	12	-	-	1	1	-	-	-	-	1	8	23
Narrow Sosi style	2	1	-	-	-	-	-	-	-	-	-	3
Heavy curvilinear line	12	1	-	1	-	-	-	-	-	-	5	19
Hatched band motifs	18	2	2	4	1	3	-	-	-	2	9	41
Isolated triangles	1	-	-	1	-	-	-	-	-	-	1	4
General solids	41	4	-	-	-	2	-	-	-	1	6	54
Bold bisecting lines	2	-	-	-	-	-	-	-	-	-	-	2
Hachure A-1	7	1	-	-	-	-	-	-	-	1	-	9
Hachure A-2	16	2	-	2	-	-	-	1	-	2	3	26
Hachure A-3	26	2	-	-	-	-	-	-	-	3	7	38
Hachure B-1	219	20	3	21	1	2	-	3	1	8	74	352
Hachure B-2	9	-	-	-	-	-	-	-	-	-	-	9

Table 2A.17. (continued)

Designs	Bowl	Ladle	Canteen	Pitcher	Tecomate	Seed Jar	Duck Pot	Miniature Effigy	Cylinder Jar	Olla	Jar	Totals
Hachure B-3	137	14	3	18	2	4	-	-	-	10	48	236
Hachure B-4	223	20	1	58	7	5	-	-	-	16	111	443
Hachure B-5	3	1	1	-	-	-	-	-	-	-	2	7
Hachure B-6	68	7	-	11	1	1	-	-	-	1	21	111
Hachure B-7	11	2	-	2	-	-	-	-	-	-	2	17
Hachure B/C	102	13	-	11	1	3	-	-	-	-	35	165
Hachure C	26	1	-	6	-	1	-	-	-	2	6	42
Counterchange	11	-	-	2	-	-	1	1*	-	-	3	18
Hatched checkerboard	45	7	-	7	-	-	1	-	1	2	7	70
Heavy Gallup squiggle	11	2	-	4	-	1	-	-	-	1	8	27
Hatched pendants	6	1	-	-	-	-	-	-	-	-	3	10
Anthro/zoomorphs	-	-	-	-	-	-	-	-	-	-	1	1
Solid ticked triangles	4	-	-	3	-	-	-	-	-	1	6	14
Bowl exterior motif	28	4	-	-	-	-	-	-	-	-	-	31
Jar neck motif	-	-	2	-	-	-	-	-	-	20	-	22
White exterior design	5	-	-	-	-	-	-	-	-	-	-	5
Narrow curvilinear	1	-	-	-	-	-	-	-	-	-	1	2
Others, solid	10	-	-	4	-	-	-	-	-	-	-	14
Others, hachure	81	6	-	13	3	2	-	-	-	1	15	121
Narrow clapboard 2-5 mm	2	-	-	-	-	-	-	-	-	-	-	2
Narrow corrugated 2-5 mm	3	-	-	-	-	-	-	-	-	-	-	3
Wide corrugated 5 mm	3	-	-	-	-	-	-	-	-	-	-	3
Unknown corrugated	1	-	-	-	-	-	-	-	-	-	-	1
Total deigns	1,225	116	13	179	18	24	5	8	3	77	409	2,077
% of designs	59.0	5.6	0.6	8.6	0.9	1.2	0.2	0.4	0.1	3.7	19.7	-
Total vessels	983	100	8	154	15	18	2	8	1	49	330	1,668
% of vessels	58.9	6.0	0.5	9.2	0.9	1.1	0.1	0.5	0.1	2.9	19.8	-

*Unknown forms excluded.

Table 2A.17. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=909, 66.9%)		
Fine to medium sandstone > sherd	185	13.6
Fine to medium sandstone < sherd	518	38.1
Coarse sandstone > sherd	59	4.3
Coarse sandstone < sherd	147	10.8
All chalcedonic sandstone*	21	1.5
Sandstone with rounded iron oxide	2	0.1
Magnetitic sandstone	6	0.4
Trachyte	71	5.2
Trachyte > sandstone	193	14.2
Sandstone > trachyte	129	9.5
Sandstone with trachyte and San Juan igneous	1	0.1
San Juan igneous with hornblende	2	0.1
San Juan igneous with sandstone	1	0.1
Sandstone with San Juan igneous with hornblende	1	0.1
San Juan igneous without hornblende	1	0.1
San Juan igneous with sandstone	5	0.4
Sandstone with San Juan igneous without hornblende	4	0.3
Unidentified igneous	1	0.1
Unidentified igneous with sandstone	2	0.1
Sandstone with unidentified igneous	9	0.7
Total	1,358	99.9

*Varieties specified: pink, n =11.

Temper Diversity H' = 1.134
s = 16 J = 0.409

2. Texture Attributes

Grain Size	No.	%
Fine	430	31.7
Medium	688	50.7
Coarse	226	16.6
Very coarse	13	1.0
Total	1,357	100.0

Density	No.	%
1-2%	13	1.1
5%	146	12.4
10%	456	38.8
20%	431	36.6
30%	122	10.4
>40%	8	0.7
Total	1,176	100.0

Sherd Temper	No.	%
None	116	8.5
< half	363	26.7
> half	827	60.9
All	52	3.8
Total	1,358	99.9

Table 2A.17. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	212	23.3
Medium	491	54.0
Coarse	196	21.6
Very coarse	10	1.1
Total	909	100.0

Texture Index	No.	%
Very fine (0-2)	372	31.6
Fine (2.1-4)	450	38.3
Fine-medium (4.1-7)	262	22.3
Medium (7.1-10)	60	5.1
Medium-coarse (10.1-13)	20	1.7
Coarse (13.1-16)	10	0.8
Very coarse (16.1+)	2	0.2
Total	1,176	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	368	30.8
Black with white sherd	135	11.3
Gray with black sherd	102	8.5
Gray with black and white	111	9.3
Gray with white sherd	344	28.8
Chuska gray homogeneous	35	2.9
Tan to brown clay	29	2.4
Black clay	9	0.8
White clay	62	5.2
Total	1,195	100.0

Vitrification	No.	%
Absent	255	18.9
Present	539	39.9
Marked	558	41.3
Total	1,352	100.0

Paste Diversity H' = 1.782
s = 9 J = 0.811

Puesga Black-on-white

References: Toll and McKenna (1987:52, MF 443-447; 1992:71-74)

Included types:

Puerco, Escavada, Gallup Black-on-whites

Similar types:

Mesa Verde: Mancos Black-on-white
Also: Reserve, Taos, Kwahe'e, Socorro Black-on-whites

Production span: A.D. 1000 to 1200

Table: 2A.18

Description:

This group is an amalgamation of Puerco, Escavada, and Gallup Black-on-whites. It was created to provide a single Chaco Cibola group from the same production span that would be comparable to Mancos Black-on-white in the Mesa Verde series. The frequencies of attributes in this "type" are more meaningful in terms of chronological change and for comparison with Mancos or Red Mesa Black-on-whites than the individual types that make up the group.

Table 2A.18. "Puesga" Black-on-white definition.

Site	Site Occurrence No.	% of Type	% of Site
29SJ 299	6	0.2	2.4
Pueblo Alto	1,470	60.8	27.3
29SJ 627	825	34.1	11.0
29SJ 628	1	0.0	0.1
29SJ 629	36	1.5	2.1
29SJ 633	22	0.9	6.9
29SJ 1360	57	2.4	2.7
Total	2,417	100.0	12.0

A. SURFACE TREATMENT

1. Decoration

Designs	Motif No. 1	2	3	No.	%
Isolated single elements	-	-	1	1	-
Hooks, flags	-	1	3	4	0.1
Nested isolates	2	1	-	3	0.1
Unnested isolates	-	2	2	4	0.1
Stars, suns	2	-	1	3	0.1
Nonoverlapping steps	-	-	1	1	-
Parallel lines	24	12	-	36	1.1
Cribbed parallel lines	4	2	-	6	0.2
Banded framers	2	1	-	3	0.1
Pendant parallel lines	30	12	-	42	1.3
Framers with unticked solids	1	1	-	2	0.1
Framers with ticked solids	-	2	-	2	0.1
Irregular wide lines	6	2	-	8	0.3
Ticking	-	4	5	9	0.3
Corner triangles	2	55	10	67	2.1
Scrolls	13	30	3	46	1.5
Dots	1	1	-	2	0.1
Framing dots	-	1	-	1	-
Linear dots	1	-	-	1	-
Dotted lines	3	16	3	22	0.7
Thick wavy lines	1	2	-	3	0.1
Parallelograms	8	1	-	9	0.3
Dots in parallelograms	-	-	1	1	-
Checkerboard	64	4	-	68	2.2
Eyed solids	8	9	4	21	0.7
Sawteeth	45	22	1	68	2.2
Barbs	90	41	5	205	6.5
Elongated scalloped triangles	22	11	1	34	1.1
Wide Sosi style	159	41	5	205	6.5
Narrow Sosi style	32	5	1	38	1.2
Heavy dotted lines	4	1	-	5	0.2
Heavy curvilinear lines	29	19	4	52	1.6
Narrow curvilinear	4	2	-	6	0.2
Solid band design	95	13	-	108	3.4

Table 2A.18. (continued)

	Motif No.				
Designs	1	2	3	No.	%
Hatched band design	29	15	2	46	1.5
Isolated triangles	7	9	1	17	0.5
General solids	65	79	-	144	4.6
Bold bisecting lines	-	2	-	2	0.1
Hachure A-1	9	-	-	9	0.3
Hachure A-2	22	4	-	26	0.8
Hachure A-3	40	2	-	42	1.3
Hachure B-1	330	23	4	357	11.3
Hachure B-2	10	1	-	11	0.3
Hachure B-3	232	-	-	232	7.4
Hachure B-4	426	18	1	445	14.1
Hachure B-5	6	-	1	7	0.2
Hachure B-6	99	14	-	113	3.6
Hachure B-7	13	5	-	18	0.6
Hachure B/C	156	9	-	165	5.2
Hachure C	42	-	-	42	1.3
Counterchange	16	2	-	18	0.6
Hatched checkerboard	59	12	2	73	2.3
Heavy Gallup squiggle	27	-	-	27	0.9
Hatched pendants	6	5	-	11	0.3
Squiggle lines	-	1	-	1	-
Interlocked frets	-	1	2	3	0.1
Anthro/zoomorphs	2	2	-	4	0.1
Solid ticked triangles	34	25	3	62	2.0
Exterior bowl motif	2	39	9	50	1.6
Jar neck motif	8	21	4	33	1.0
White exterior design	-	4	4	8	0.3
Interlocked ticking	-	5	2	7	0.2
Others, solid	4	12	-	16	0.5
Others, hachure	114	14	1	129	4.1
Narrow clapboard 2-5 mm	-	2	-	2	0.1
Narrow corrugated 2-5 mm	1	1	2	4	0.2
Wide corrugated 5 mm	-	3	2	5	0.2
Undifferentiated corrugated	-	1	-	1	-
Oblique corrugated	1	-	-	1	-
Totals	2,412	652	92	3,156	100.1
No. with 1, 2, 3 treatments	1,760	560	92	2,412	-
% with 1, 2, 3 treatments	73.0	23.2	3.8	-	100.0

Type Design Diversity H' = 3.300
s = 69 J = 0.779
Design Distribution Diversity H' = 0.634
s = 3 J = 0.577

Table 2A.18. (continued)

2. Paint

Type		No.	%
Mineral:	red	57	2.4
	brown	638	26.4
	green	36	1.5
	black	1,609	66.6
	glaze	67	2.8
Mineral-carbon		2	0.1
Unknown		6	0.2
Total		2,415	100.0

Rim Decoration	No.	%
Unpainted	243	10.1
Solid line	1,267	52.5
Dotted	30	1.2
Eroded, solid line	85	3.5
Use-ground	128	5.3
Unknown	662	27.4
Total	2,415	100.0

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	85	5.1	28	3.8	113	4.7
None	220	13.2	56	7.6	276	11.5
One side						
Streaky	120	7.2	31	4.2	151	6.3
Moderate	216	13.0	95	12.8	311	12.9
Completely polished	758	45.5	531	71.7	1,289	53.5
Both sides						
Streaky	17	1.0	-	-	17	0.7
Moderate	31	1.9	-	-	31	1.3
Completely polished	94	5.6	-	-	94	3.9
Differential interior/exterior polish	126	7.6	-	-	126	5.2
Totals	1,667	69.2	741	30.8	2,408	100.0

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	175	10.5	46	6.2	221	9.2
Interior	708	42.5	-	-	708	29.4
Exterior	-	-	550	74.2	550	22.8
Slipslop	320	19.2	132	17.8	452	18.8
Both sides	398	23.9	1	0.1	399	16.6
Unknown	66	4.0	12	1.6	78	3.2
Totals	1,667	69.2	741	30.8	2,408	100.0

*Unknown forms excluded n = 5.

Table 2A.18. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	1,468	60.8	1,133	50-360	211.8	65.780	31.1
Ladle	201	8.3	113	60-240	114.4	33.535	29.3
Jar	414	17.1	29	40-140	76.9	22.217	28.9
Olla	69	2.9	40	50-110	78.3	13.036	16.7
Pitcher	187	7.7	157	10-180	87.9	23.260	26.5
Seed jar	25	1.0	18	50-190	112.5	37.973	33.8
Tecomate	18	0.8	14	35-190	101.1	47.563	47.1
Canteen	13	0.5	11	20- 40	30.5	7.230	23.7
Duck pot	2	0.1	-	-	-	-	-
Miniatures	7	0.3	6	25- 40	30.0	5.477	18.3
Effigy	4	0.2	-	-	-	-	-
Mug/cup	1	-	1	80	-	-	-
Cylinder jar	1	-	1	140	-	-	-
Unknown	5	0.2					
Total	2,415	99.9					

Diversity of Forms H' = 1.264
s = 13 J = 0.493

6. Handles

Type	No.	%
Solid coil	8	3.6
Multi-coil	1	0.5
Strap	48	21.8
Tubular	33	15.0
Perforated tubular	4	1.8
Trough	68	30.9
Nubbin	3	1.4
Indented	6	2.7
Strap lug	26	11.8
Tabular lug	8	3.6
Sagging nubbins	1	0.5
Perforated nubbin lug	8	3.6
Multi-coil strap lug	5	3.6
Effigy	1	0.5
Total	220	100.0

Handles:items = 1:11
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
Absent	2,298	95.2
Blackening	44	1.8
Fugitive red	16	0.7
Mineral encrustation	56	2.3
Total	2,414	100.0

Worked sherds = 158 (6.5%).

Table 2A.18. (continued)

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Pitcher	Canteen	Tecomate	Seed Jar	Gourd Jar	Olla	Other* Closed	Jar	Total
Hooks, flags	21	2	-	-	-	-	-	1	-	1	25
Nested isolates	14	1	1	-	-	-	-	-	-	3	19
Nonoverlapping steps	-	1	-	-	-	-	-	-	-	-	1
Parallel lines	330	24	8	1	-	1	1	12	5	81	463
Cribbed parallel lines	15	-	-	-	-	1	-	7	4	20	47
Pendant parallel lines	141	13	9	1	1	2	-	5	1	24	197
Framers with unticked solids	63	4	2	-	-	-	-	5	-	26	100
Framers with ticked solids	97	4	1	-	-	3	-	6	1	36	148
Irregular wide lines	1	-	-	-	1	-	-	-	-	-	2
Ticking	7	-	-	1	-	-	-	-	-	-	8
Corner triangles	20	4	-	-	-	-	-	-	-	2	26
Scrolls	338	77	20	4	4	7	2	11	5	51	519
Dots	7	1	-	-	-	1	-	-	3	5	17
Other framed isolates	1	-	1	-	-	-	-	-	-	-	2
Framing dots	11	-	-	-	-	-	-	1	-	5	17
Dotted lines	170	17	3	-	-	1	1	4	-	46	242
Thick wavy lines	26	4	-	1	-	1	-	-	-	5	37
Parallelograms	2	-	-	-	-	-	-	-	-	1	3
Checkerboard	234	12	3	2	-	5	-	2	3	7	268
Eyed solids	16	-	1	-	-	1	-	-	-	5	23
Sawteeth	150	20	4	1	3	4	-	6	5	34	227
Barbs	55	12	3	-	-	1	-	1	-	6	78
Elongated scalloped triangles	6	2	-	-	-	-	-	1	-	3	12
Wide Sosi style	8	-		-	-	-	-	1	-	2	12
Narrow Sosi style	28	3	-	-	1	2	-	1	-	3	38
Heavy dotted lines	9	5	-	-	-	-	-	1	-	1	16
Heavy curvilinear line	1	1	-	-	-	-	-	-	-	1	3
Solid band design	829	180	45	6	4	11	3	25	8	94	1,205
Hatched band motifs	5	-	-	-	-	-	-	2	-	-	7
Isolated triangles	3	-	-	-	-	-	-	1	-	1	5
General solids	239	16	7	1	-	3	-	5	1	32	304
Hachure A-1	208	25	7	2	-	4	-	4	4	43	307

Table 2A.18. (continued)

Designs	Bowl	Ladle	Pitcher	Canteen	Tecomate	Seed Jar	Gourd Jar	Olla	Other* Closed	Jar	Total
Hachure A-2	12	4	-	-	-	1	-	2	1	2	22
Hachure A-3	8	-	1	-	-	1	-	-	-	2	12
Hachure B-1	10	1	-	-	-	-	-	1	-	-	12
Hachure B-2	1	2	-	-	-	-	-	-	-	1	4
Hachure B-3	139	14	18	3	2	4	-	10	-	48	239
Hachure B-4	1	-	-	-	-	-	-	1	-	-	2
Hachure B-5	1	-	-	-	-	-	-	-	-	-	1
Hachure B-6	2	-	-	-	-	-	-	1	-	-	3
Hachure B/C	8	2	-	-	-	-	-	-	-	4	14
Hatched checkerboard	5	-	-	-	-	-	-	-	-	-	5
Heavy Gallup squiggle	2	-	-	-	-	-	-	-	-	3	5
Squiggle lines	204	56	2	2	4	2	1	1	4	13	289
Interlocked frets	2	-	-	-	-	-	-	-	-	1	3
Anthro/zoomorphs	-	-	-	-	-	-	-	-	-	1	1
Solid ticked triangles	346	33	15	1	-	4	1	18	-	78	496
Bowl exterior motif	36	4	-	-	2	-	-	-	-	-	42
Jar neck motif	-	-	-	1	-	-	-	16	2	5	24
Narrow curvilinear	3	-	-	-	-	-	-	-	-	-	3
Interlocked ticking	98	13	4	2	-	1	1	1	1	13	134
Others, solid	11	1	-	-	-	-	-	-	-	1	13
Others, hachure	10	-	2	-	-	-	-	-	-	-	12
Banded, undifferentiated	3	-	-	-	-	-	-	-	-	-	3
Wide neckbanded > 5 mm	2	-	-	-	-	-	-	-	-	-	2
Narrow clapboard 2-5 mm	1	-	-	-	-	-	-	-	-	-	1
Wide clapboard > 5 mm	1	-	-	-	-	-	-	-	-	-	1
Narrow corrugated 2-5 mm	1	-	-	-	-	-	-	-	-	1	2
Wide corrugated > 5 mm	-	1	-	-	-	-	-	-	-	-	1
Total designs	3,962	569	158	29	22	61	10	153	48	710	5,722
% of designs	69.2	9.9	2.8	0.5	0.4	1.1	0.2	2.7	0.8	12.4	-
Total vessels	2,703	408	89	15	12	33	5	75	31	416	3,787
% of vessels	71.4	10.8	2.4	0.4	0.3	0.9	0.1	2.0	0.8	11.0	

* Includes miniatures 13; effigy 19; pipe 1; duck pot 15.

Table 2A.18. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=1,433, 72.6%)		
Fine to medium sandstone > sherd	257	13.0
Fine to medium sandstone < sherd	785	39.8
Coarse sandstone > sherd	106	5.4
Coarse sandstone < sherd	285	14.4
All chalcedonic sandstone*	39	2.0
Sandstone with rounded iron oxide	2	0.1
Magnetitic sandstone	9	0.5
Trachyte	82	4.2
Trachyte > sandstone	207	10.5
Sandstone > trachyte	153	7.8
San Juan igneous with hornblende	2	0.1
San Juan igneous with sandstone	4	0.2
Sandstone with San Juan igneous with hornblende	1	0.1
San Juan igneous without hornblende	3	0.1
San Juan igneous with sandstone	9	0.5
Sandstone with San Juan igneous without hornblende	6	0.3
Unidentified igneous	2	0.1
Unidentified with sandstone	3	0.1
Sandstone with unidentified igneous	16	0.8
Andesite with sandstone	1	0.1
Shale	1	0.1
Total	1,973	100.0

*Varieties specified: pink n = 22.

Temper Diversity $H' = 1.041$
$s = 17$ $J = 0.367$

2. Texture Attributes

Grain Size	No.	%	Density	No.	%	Sherd Temper	No.	%
Fine	521	26.4	1-2%	28	1.6	None	164	8.3
Medium	1,011	51.3	5%	275	15.9	< half	490	24.8
Coarse	416	21.1	10%	705	40.8	> half	1,227	62.2
Very coarse	24	1.2	20%	566	32.8	All	92	4.7
Total	1,972	100.0	30%	142	8.2	Total	1,973	100.0
			> 40%	12	0.7			
			Total	1,728	100.0			

Table 2A.18. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	280	19.5
Medium	762	53.2
Coarse	371	25.9
Very coarse	20	1.4
Total	1,433	100.0

Texture Index	No.	%
Very fine (0-2)	492	28.5
Fine (2.1-4)	677	39.2
Fine-medium (4.1-7)	416	24.1
Medium (7.1-10)	90	5.2
Medium-coarse (10.1-13)	26	1.5
Coarse (13.1-16)	20	1.2
Very coarse (16.+)	7	0.4
Total	1,728	100.1

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	545	31.1
Black with white sherd	199	11.3
Gray with black sherd	170	9.7
Gray with black and white	174	9.9
Gray with white sherd	477	27.2
Chuska gray homogeneous	38	2.2
Tan to brown clay	44	2.5
Black clay	11	0.6
White clay	96	5.5
Total	1,754	100.0

Vitrification	No.	%
Absent	383	19.5
Present	770	39.2
Marked	812	41.3
Total	1,965	100.0

Paste Diversity $H' = 1.786$
$s = 9$ $J = 0.813$

Chaco Black-on-white

References: Vivian (1959); Windes (1977:344-346, 1984b:111-112)

Synonyms:

Chuska Mineral: None; sherds matching the design criteria for Chaco Black-on-white and containing some trachyte temper (31 percent of the sample) are called Chaco Black-on-white here; no examples of this type with pure trachyte temper were recorded. The closest Chuska mineral type is Chuska Black-on-white.
Hachure C (Roberts 1927)

Similar types:

Chuska Carbon: absent? perhaps some Chuska Black-on-white
Mesa Verde: Mancos Black-on-white
Tusayan:

Production span: A.D. 1075 to 1150

Table: 2A.19

Description:

In spite of its name and the general association of Chaco Black-on-white with Chaco Canyon, and especially Chaco greathouses, the Chaco Black-on-white type occurs relatively infrequently. It does not exceed 1 percent of any site ceramic assemblage in this study. This is, in part, due to this analysis's rigorous requirement that items assigned to this type have very well-executed, closely-spaced hachure lines that are markedly thinner than the framing lines. A less exclusive definition in other analyses means that this analysis placed some sherds in Gallup Black-on-white, but they are called Chaco Black-on-white in other analyses. The large numbers of this type reported by Vivian and Mathews (1965:71) result both from a more inclusive definition of the type and the early A.D. 1100s date of Kin Kletso. Five of the seven sherds illustrated by Vivian (1959:26) would have been classified as Gallup Black-on-white in this analysis, as would three of the four classified as Chaco Black-on-white by Goetze and Mills (1993:35).

Consistent with its extremely well-executed decoration, Chaco Black-on-white pastes are generally also well produced, being thin, hard, and well-fired. Mineral paint fired so as to appear "glazey" occurs in 8 percent of this sample as opposed to only 3 percent of the Puesga Black-on-white group. Marked vitrification is somewhat higher in Chaco Black-on-white than in Puesga Black-on-white, but both groups have over 40 percent high-fired cases.

As the best-executed examples of hachure, which is thought by some to be a Chaco hallmark (but see Toll et al. 1992), Chaco Black-on-white is sometimes accorded enhanced significance, perhaps as a possession of the elite (Neitzel and Bishop 1991:69). The high level of brush control and the complexity of the designs are indicative of highly skilled—to some degree specialized—potters (see Jernigan 1986:50). Although there is no way to quantify this other than in terms of occurrence in this collection, there is little question that Chaco Black-on-white vessels are illustrated disproportionately to their occurrence, again because of their high craftsmanship and striking appearance.

Unlike practically all other whiteware types, closed forms outnumber bowls in Chaco Black-on-white (Table 2.14B); bowls are only 30 percent of this sample, which is around half their relative frequency in other types. Jars and pitchers form higher percentages of this relatively small sample than in any of the other decorated types. Ladles, on the other hand, are infrequent.

Figures: 2A.16 and 2A.17

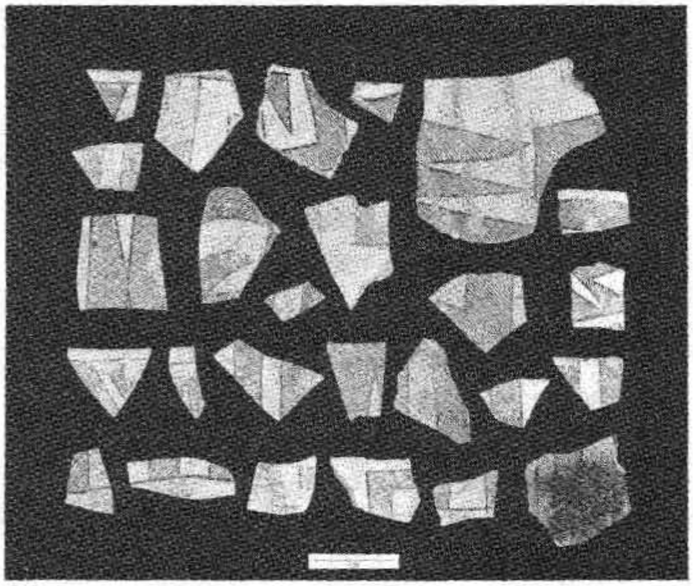


Figure 2A.16. *Chaco Black-on-white sherds from Chetro Ketl (also used in Windes 1984). (NPS Chaco Archive Negative No. 23167).*

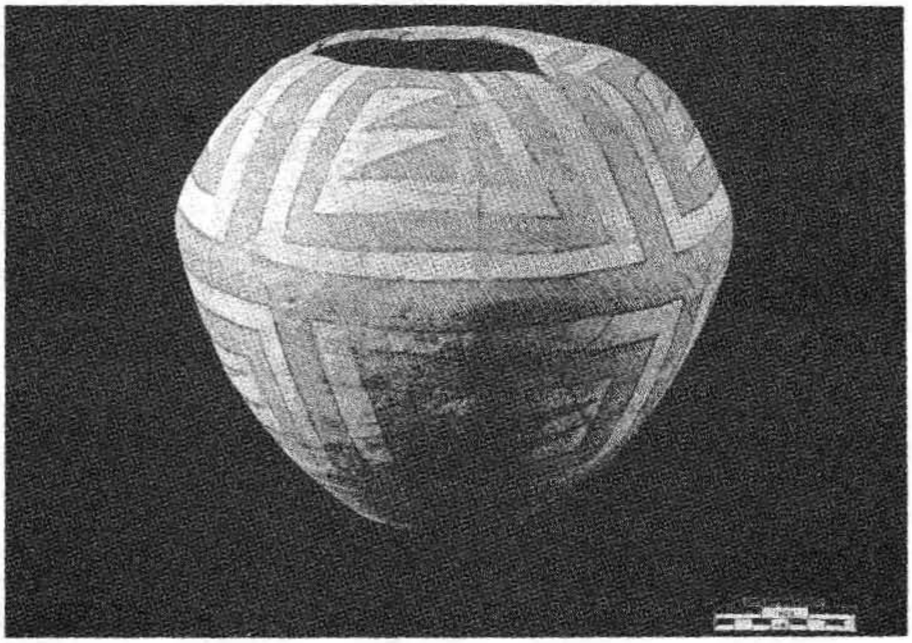


Figure 2A.17. *Large jar from 29SJ 627. (NPS Chaco Archive Negative No. 13987).*

Table 2A.19. Chaco Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	-	-	-
Pueblo Alto	42	56.8	0.8
29SJ 423	-	-	-
29SJ 627	26	35.1	0.3
29SJ 628	-	-	-
29SJ 629	-	-	-
29SJ 633	3	4.1	0.9
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	3	4.1	0.1
Shabik'eshchee	-	-	-
Total	74	100.1	0.4

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hatched band design	2	-	-	2	2.5
Hachure B-1	1	1	-	2	2.5
Hachure B-4	8	-	-	8	9.9
Hachure B/C	3	-	-	3	3.7
Hachure C	58	2	-	60	74.1
Hatched checkerboard	2	-	-	2	2.5
Exterior bowl motif	-	1	-	1	1.2
Jar neck motif	-	2	-	2	2.5
Totals	74	7	-	81	100.1
No. with 1, 2, 3 treatments	67	7	-	74	-
% with 1, 2, 3 treatments	90.5	9.5	-	-	100.0

Type Design Diversity H' = 1.047
s = 9 J = 0.477
Design Distribution Diversity H' = 0.313
s = 2 J = 0.452

2. Paint

Type		No.	%
Mineral:	brown	13	17.6
	green	2	2.7
	black	52	70.3
	glaze	6	8.1
Carbon		1	1.3
Total		74	100.0

Rim Decoration	No.	%
Solid line	30	40.5
Eroded, solid line	1	1.4
Use-ground	2	2.7
Unknown	41	55.4
Total	74	100.0

Table 2A.19. (continued)

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	-	-	2	3.9	2	2.7
None	1	4.4	-	-	1	1.4
One side						
Streaky	1	4.4	-	-	1	1.4
Moderate	2	8.7	2	3.9	4	5.4
Completely polished	15	65.2	47	92.2	62	83.8
Both sides						
Streaky	-	-	-	-	-	-
Moderate	-	-	-	-	-	-
Completely polished	3	13.0	-	-	3	4.0
Differential interior/exterior polish	1	4.4	-	-	1	1.4
Totals	23	31.1	51	68.9	74	100.1

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	-	-	-	-	-	-
Interior	12	52.2	-	-	12	16.2
Exterior	-	-	40	78.4	40	54.1
Slipslop	4	17.4	10	19.6	14	18.9
Both sides	7	30.4	-	-	7	9.5
Unknown	-	-	1	2.0	1	1.4
Totals	23	31.1	51	68.9	74	100.0

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	22	29.7	18	130-330	196.1	44.575	22.8
Ladle	1	1.4	1	85	-	-	-
Jar	26	35.1	1	80	-	-	-
Pitcher	20	27.0	12	50-100	82.1	14.055	17.1
Olla	2	2.7	1	70	-	-	-
Canteen	1	1.4					
Tecomate	1	1.4					
Miniatures	1	1.4					
Total	74	100.1					

Diversity of Forms $H' = 1.412$
$s = 8 \quad J = 0.679$

6. Handles

Type	No.	%
Strap	5	55.6
Strap lug	2	22.2
Perforated nubbin lug	1	11.1
Multi-coil strap lug	1	11.1
Total	9	100.0

Handles:items = 1:8
(Excluding ladles from forms and handles)

Table 2A.19. (continued)

7. Surface Alteration

Type	No.	%
None	65	87.8
Blackening	3	4.1
Fugitive red	2	2.7
Mineral encrustation	4	5.4
Total	74	100.0

Worked sherds = 4 (5.4%).

8. Designs by Vessel Forms*

Designs	Bowl	Ladle	Canteen	Pitcher	Tecomate	Miniature	Olla	Jar	Total
Hached band design	1	-	-	1	-	-	-	-	2
Hachure B-1	-	-	-	2	-	-	-	-	2
Hachure B-4	-	-	-	4	-	1	-	3	8
Hachure B/C	1	1	-	1	-	-	-	-	3
Hachure C	21	-	1	12	1	-	2	23	60
Hatched checkerboard	1	-	-	1	-	-	-	-	2
Bowl exterior motif	1	-	-	-	-	-	-	-	1
Jar neck motif	-	-	1	-	-	-	1	-	2
Others, solid	-	-	-	1	-	-	-	-	1
Total designs	25	1	2	22	1	1	3	26	81
% of designs	30.9	1.2	2.5	27.2	1.2	1.2	3.7	32.1	-
Total vessels	22	1	1	20	1	1	2	26	74
% of vessels	29.7	1.4	1.4	27.0	1.4	1.4	2.7	35.1	-

* Unknown forms excluded.

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=47, 63.5%)		
Fine to medium sandstone > sherd	15	31.9
Fine to medium sandstone < sherd	30	63.8
Coarse sandstone > sherd	-	-
Coarse sandstone < sherd	2	4.3
Trachyte > sandstone	11	14.9
Sandstone > trachyte	12	16.2
Unidentified igneous with sandstone	2	2.7
Sandstone with unidentified igneous	2	2.7
Total	74	100.0

Temper Diversity $H' = 1.062$
$s = 5$ $J = 0.660$

Table 2A.19. (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	39	52.7
Medium	32	43.2
Coarse	3	4.1
Very coarse	-	-
Total	74	100.0

Density	No.	%
1-2%	1	1.5
5%	15	21.7
10%	28	40.6
20%	23	33.3
30%	2	2.9
>40%	-	-
Total	69	100.0

Sherd Temper	No.	%
None	8	10.8
< half	25	33.8
> half	41	55.4
All	-	-
Total	74	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	21	44.7
Medium	24	51.1
Coarse	2	4.2
Very coarse	-	0.1
Total	74	100.0

Texture Index	No.	%
Very fine (0-2)	35	50.7
Fine (2.1-4)	21	30.4
Fine-medium (4.1-7)	7	10.1
Medium (7.1-10)	3	4.4
Medium-coarse (10.1-13)	3	4.4
Coarse (13.1-16)	-	-
Very coarse (16.1+)	-	-
Total	69	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	29	42.0
Black with white sherd	6	8.7
Gray with black & white	3	4.3
Gray with white sherd	28	40.6
White clay	3	4.3
Total	69	99.9

Vitrification	No.	%
Absent	12	16.2
Present	29	39.2
Marked	33	44.6
Total	74	100.0

Paste Diversity H' = 1.215
s = 5 J = 0.755

Exotic Mineral-on-white

Synonyms:

Cibola Mineral: Socorro, Cebolleta, Reserve Black-on-whites
Chuska Mineral: all types
Mesa Verde: all types, especially Cortez and Mancos Black-on-whites

Production span: A.D. 900 to 1200

Table: 2A.20

Description:

This type group is similar to "Decorated Redware" in background and problems. It includes Pueblo II-Pueblo III mineral-painted sherds that were recognized as not belonging to the Cibola Whiteware Chaco Series. As in the redwares, the analysts usually had a very good idea as to detailed series and type, but the evolution of the procedure assumed identification in another phase which did not take place. In the tables here, the type has been subdivided into temper groups. In this division, rock-tempered items from the Mesa Verde series fall into a distinctive group, but sand-tempered ones fall into a more generic group. The majority of trachyte-tempered, mineral-painted sherds were placed with the primary Cibola types (see the temper counts for Red Mesa or Gallup Black-on-whites, for example). Fifty-six such sherds were, however, called Exotic Mineral-on-white, presumably because of markedly Chuskan slips or very dense trachyte temper.

The type was used at all sites, more or less in proportion to the site's sample size, although it is less frequent in the earliest contexts. This results not from fewer vessels being imported from northern and other areas, but from inclusion of the earliest types in the Basketmaker III-Pueblo I polished and unpolished types, and from the generally similar appearance of vessels in early time periods (note the relatively high frequencies of San Juan tempers in the Basketmaker III-Pueblo I types, Tables 2A.11 and 2A.12).

Slip was an important tip to placement in this group: crackled slips usually indicate production north of the San Juan River; extremely smooth, creamy slips suggest Cebolleta Black-on-white from the Acoma area; yellowish, streaky slip on a dark gray paste is a Chuskan earmark; absent or nearly absent slip with stark black paint suggests Socorro Black-on-white, or some varieties of Mancos Black-on-white. All of these slips contrast to the thinner, matte slip common to the predominant Cibola types.

Sherds fulfilling the criteria for Cebolleta and Socorro Black-on-whites are uncommon in these collections. The identification of the small black specks in Socorro Black-on-white (see hornblende latite in temper and paste section) allows some indication of the occurrence of this type: only five sherds, mostly from Pueblo Alto. Some "unidentified igneous" (the majority of the "other" subgroup) may be Socorro Black-on-white, but the most likely placement for these items is the Mesa Verde series, as well. The majority of sand-tempered items in Exotic Mineral-on-white are likely to be from the Mesa Verde series.

Table 2A.20. Exotic Mineral-on-white definition.

	Exotic Mineral Breakdown												
	San Juan		Sandstone		Trachyte		Socorro		Other		Total		
Site Number	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Type	% of Site
29SJ 299 BMIII	1	1.7	1	0.5	-	-	-	-	1	1.5	3	0.8	0.6
29SJ 299 PI	-	-	3	1.4	-	-	-	-	-	-	3	0.8	1.2
Pueblo Alto	21	35.6	45	21.4	27	48.2	4	80.0	40	61.5	137	34.7	2.5
29SJ 627	25	42.4	119	56.7	17	30.4	-	-	5	7.7	166	42.0	2.2
29SJ 628	-	-	1	0.5	-	-	-	-	-	-	1	0.3	0.1
29SJ 629	5	8.5	18	8.6	2	3.6	1	20.0	3	4.6	29	7.3	1.7
29SJ 633	1	1.7	7	3.3	1	1.8	-	-	9	13.8	18	4.6	5.7
29SJ 721	-	-	-	-	1	1.8	-	-	-	-	1	0.3	0.7
29SJ 1360	6	10.2	16	7.6	8	14.3	-	-	7	10.8	37	9.4	1.8
Totals	59	100.0	210	100.0	56	100.0	5	100.0	65	100.0	395	100.0	2.0

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Time	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% Total
Tight Dates A.D. 700-820	-	-	3	1.5	1	1.9	-	-	-	-	4	1.1
A.D. 820-920	3	5.7	2	1.0	1	1.9	-	-	1	1.6	7	1.8
A.D. 920-1040	19	35.8	71	34.6	13	24.1	1	20.0	12	19.0	116	30.5
A.D. 1040-1120	13	24.5	18	8.8	18	33.3	1	20.0	33	52.4	83	21.8
A.D. 1120-1220	5	9.4	19	9.3	7	13.0	2	40.0	3	4.8	36	9.5
A.D. 1220-1320	-	-	-	-	-	-	-	-	1	1.6	1	.3
Grouped Dates A.D. 920-1120	3	5.7	12	5.9	1	1.9	-	-	-	-	16	4.2
A.D. 920-1220	-	-	1	0.5	1	1.9	-	-	-	-	2	0.5
A.D. 820-1020	2	3.8	6	2.9	-	-	-	-	-	-	8	2.1
A.D. 500-1200	-	-	-	-	1	1.9	-	-	-	-	1	0.3
A.D. 920-1320	-	-	4	2.0	1	1.9	-	-	7	11.1	12	3.2
A.D. 1120-1320	-	-	1	0.5	-	-	-	-	1	1.6	2	0.5
A.D. 700-1020	-	-	1	0.5	-	-	-	-	-	-	1	0.3
A.D. 1020-1220	1	1.9	5	2.4	2	3.7	1	20.0	3	4.8	12	3.2
A.D. 900-1130	5	9.4	57	27.8	8	14.8	-	-	2	3.2	72	18.9
A.D. 820-1120	2	3.8	5	2.4	-	-	-	-	-	-	7	1.8
Totals	53	100.0	205	100.0	54	100.0	5	100.0	63	100.0	380	100.0

Table 2A.20. (continued)

A. Surface Treatment

1. Decoration

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Motif	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Hooks, flags	-	-	1	0.3	1	1.2	-	-	-	-	2	0.3
Nested isolates	-	-	2	0.6	-	-	-	-	-	-	2	0.3
Unnested isolates	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Stars, suns	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Non-overlapping steps	-	-	-	-	1	1.2	-	-	-	-	1	0.2
Parallel lines	8	9.3	20	6.4	7	8.5	1	14.3	4	4.1	40	6.8
Cribbed parallel lines	-	-	4	1.3	1	1.2	-	-	-	-	5	0.9
Banded framers	1	1.2	-	-	-	-	1	14.3	-	-	2	0.3
Pendant parallel lines	5	5.8	13	4.1	3	3.7	-	-	2	2.1	23	3.9
Framers with unticked solids	1	1.2	7	2.2	1	1.2	-	-	2	2.1	11	1.9
Framers with ticked solids	-	-	2	0.6	1	1.2	-	-	2	2.1	5	0.9
Irregular wide lines	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Ticking	1	1.2	-	-	4	4.9	-	-	-	-	5	0.9
Corner triangles	-	-	1	0.3	2	2.5	-	-	2	2.1	5	0.9
Scrolls	3	3.5	12	3.8	3	3.7	1	14.3	3	3.1	22	3.7
Dots	1	1.2	-	-	-	-	-	-	1	1.0	2	0.3
Framing dots	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Linear dots	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Dotted lines	2	2.4	11	3.5	-	-	-	-	1	1.0	14	2.4
Thick wavy lines	2	2.4	1	0.3	-	-	-	-	-	-	3	0.5
Parallelograms	1	1.2	1	0.3	-	-	-	-	-	-	2	0.3
Dots in parallelograms	-	-	-	-	-	-	-	-	1	1.0	1	0.2
Checkerboard	4	4.7	11	3.5	3	3.7	-	-	4	4.1	22	3.8
Eyed solids	-	-	6	1.9	1	1.2	-	-	2	2.1	9	1.5
Sawteeth	4	4.7	20	6.4	3	3.7	1	14.3	8	8.2	36	6.1
Barbs	-	-	8	2.5	3	3.7	-	-	2	2.1	13	2.2
Elongated scalloped triangles	-	-	1	0.3	-	-	-	-	-	-	1	0.2
Straight lines >5 mm	2	2.4	10	3.2	1	1.2	-	-	3	3.1	16	2.7

Table 2A.20. (continued)

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Motif	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Dotted lines >2 mm	1	1.2	2	0.6	-	-	-	-	1	1.0	4	0.7
Heavy curvilinear Sosi lines	2	2.4	9	2.9	-	-	1	14.3	6	6.3	18	3.1
Solid band design	9	10.5	29	9.2	3	3.7	-	-	6	6.2	47	8.0
Hatched band design	1	1.2	2	0.6	1	1.2	-	-	-	-	4	0.7
Isolated triangles	-	-	2	0.6	-	-	-	-	3	3.1	5	0.9
General solids	8	9.3	23	7.3	1	1.2	1	14.3	6	6.2	39	6.6
Bold bisecting lines	-	-	-	-	-	-	-	-	1	1.0	1	0.2
Hachure A-1	4	4.7	7	2.2	3	3.7	-	-	3	3.1	17	2.9
Hachure A-2	-	-	1	0.3	1	1.2	-	-	-	-	2	0.3
Hachure A-3	1	1.2	6	1.9	1	1.2	-	-	-	-	8	1.4
Hachure B-1	4	4.7	20	6.4	3	3.7	-	-	5	5.2	32	5.5
Hachure B-2	1	1.2	1	0.3	-	-	-	-	-	-	23	0.3
Hachure B-3	1	1.2	7	2.2	6	7.3	-	-	1	1.0	15	2.6
Hachure B-4	1	1.2	6	1.9	4	4.9	-	-	2	2.1	13	2.2
Hachure B-6	-	-	4	1.3	1	1.2	-	-	3	3.1	8	1.4
Cross-hatched B-7	5	5.8	5	1.6	2	2.4	1	14.3	2	2.1	15	2.6
Hachure B/C	1	1.2	1	0.3	1	1.2	-	-	-	-	3	0.5
Hachure C	-	-	1	0.3	2	2.4	-	-	2	2.1	5	0.9
Counterchange	-	-	16	5.1	-	-	-	-	2	2.1	18	3.1
Hatched checkerboard	1	1.2	-	-	4	4.9	-	-	1	1.0	6	1.0
Heavy line Gallup squiggle	-	-	-	-	1	1.2	-	-	-	-	1	0.2
Hatched pendant triangles	-	-	-	-	-	-	-	-	2	2.1	2	0.3
Multiple squiggle lines	1	1.2	2	0.6	2	2.4	-	-	1	1.0	6	1.0
Interlocked frets or steps	-	-	1	0.3	1	1.2	-	-	-	-	2	0.3
Anthro/zoomorphic	1	1.2	1	0.3	-	-	-	-	1	1.0	3	0.5
Solid ticked triangles	4	4.7	10	3.2	2	2.4	-	-	2	2.1	18	3.1
Painted design on exterior	1	1.2	3	1.0	2	2.4	-	-	4	4.1	10	1.7
Exterior jar rim design	-	-	1	0.3	1	1.2	-	-	1	1.0	3	0.5
Straight geometric lines 2-5 mm	1	1.2	3	1.0	1	1.2	-	-	1	1.0	6	1.0
Straight Sosi geometric lines 2-5 mm	-	-	5	1.6	-	-	-	-	1	1.0	6	1.0
Interlocking ticking from solid elements	-	-	1	0.3	1	1.2	-	-	-	-	2	0.3

Table 2A.20. *(continued)*

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Motif	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Other solid	-	-	2	0.6	-	-	-	-	-	-	2	0.3
Other hatched	1	1.2	6	1.9	2	2.4	-	-	2	2.1	11	1.9
Narrow neckbanding	-	-	-	-	-	-	-	-	1	1.0	1	0.2
Narrow corrugation	-	-	1	-	1	1.2	-	-	-	-	2	0.3
Wide corrugation	2	2.3	-	-	-	-	-	-	-	-	23	0.3
Totals	86	100.0	314	100.0	82	100.0	7	100.0	97	100.0	586	100.0
No. with no treatments	1	1.7	3	1.4							4	1.0
No. with 1 treatment	37	62.7	121	57.6	37	66.1	3	60.0	37	56.9	235	59.5
No. with 2 treatments	14	23.7	64	30.5	12	21.4	2	40.0	24	36.9	116	29.4
No. with 3 treatments	7	11.9	22	10.5	7	12.5	0	-	4	6.2	40	10.1
Totals	59	100.0	210	100.0	56	100.0	5	100.0	65	100.0	395	100.0

2. Paint

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Type	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Unpainted	-	-	1	0.5	-	-	-	-	-	-	1	0.3
Mineral: red	2	3.4	11	5.2	5	8.9	-	-	1	1.5	19	4.8
brown	17	28.8	77	36.7	25	44.6	-	-	15	23.1	134	33.9
black	25	42.4	99	47.1	23	41.1	4	80.0	37	56.9	188	47.6
green	14	23.7	9	4.3	2	3.6	-	-	6	9.2	31	7.8
glaze	-	-	12	5.7	-	-	1	20.0	3	4.6	16	4.1
Mineral-carbon	-	-	-	-	-	-	-	-	1	1.5	1	0.3
Carbon	1	1.7	1	0.5	-	-	-	-	-	-	2	0.5
Unknown	-	-	-	-	1	1.8	-	-	2	3.1	3	0.8
Totals	59	100.0	210	100.0	56	100.0	5	100.0	65	100.0	395	100.0

Table 2A.20. (continued)

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Rim Decoration	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Unpainted	6	10.3	22	10.5	9	16.1	-	-	9	13.8	46	11.7
Solid	25	43.1	59	28.1	18	32.1	3	60.0	27	41.5	132	33.5
Dots or dashes	-	-	7	3.3	-	-	-	-	-	-	7	1.8
Eroded Paint	1	1.7	6	2.9	1	1.8	-	-	3	4.6	11	2.8
Use-ground	2	3.4	9	4.3	4	7.1	-	-	8	12.3	23	5.8
Unknown	24	41.4	107	51.0	24	42.9	2	40.0	18	27.7	175	44.4
Totals	58	100.0	210	100.0	56	100.0	5	100.0	65	100.0	394	100.0

Table 2A.20. (continued)

3. Polish

	Grouped Forms					
	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	6	2.1	2	1.9	8	2.0
None	5	1.7	4	3.7	9	2.3
One side						
Streaky	5	1.7	1	0.9	6	1.5
Moderate	8	2.8	9	8.3	17	4.3
Completely polished	82	28.7	90	83.3	172	43.7
Both sides						
Streaky	2	0.7	-	-	2	0.5
Moderate	6	2.1	-	-	6	1.5
Completely polished	121	42.3	2	1.9	123	31.2
Differential interior/exterior polish	51	17.8	-	-	-	12.9
Totals	286	100.0	108	100.0	394	100.0

4. Slip

	Grouped Forms					
	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	17	5.9	7	6.5	24	6.1
Interior only	60	21.0	1	0.9	61	15.5
Exterior only	6	2.1	93	86.1	99	25.1
Slipslop	6	2.1	4	3.7	10	2.5
Both sides	191	66.8	1	0.9	192	48.7
Unknown	6	2.1	2	1.9	8	2.0
Totals	186	100.0	108	100.0	394	100.0

Table 2A.20. (continued)

5. Forms and Metrics

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Form	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Bowl	42	71.2	126	60.3	36	64.3	4	80.0	44	67.7	252	64.0
Canteen	1	1.7	3	1.4	1	1.8	-	-	-	-	5	1.3
Duck pot	-	-	1	0.5	-	-	-	-	-	-	1	0.3
Ladle	5	8.5	12	5.7	6	10.7	-	-	11	16.9	34	8.6
Pitcher	-	-	2	1.0	2	3.6	-	-	2	3.1	6	1.5
Seed jar	-	-	-	-	-	-	-	-	1	1.5	1	0.3
Tecomate	-	-	-	-	-	-	-	-	1	1.5	1	0.3
Olla	1	1.7	3	1.4	-	-	-	-	-	-	4	1.0
Gourd jar	-	-	1	0.5	1	1.8	-	-	-	-	2	0.5
Whiteware jar	10	16.9	61	29.2	10	17.9	1	20.0	6	9.2	88	22.3
Totals	59	100.0	209	100.0	56	100.0	5	100.0	65	100.0	394	100.0

		Orifice Diameter (mm)			
Form	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	158	60-350	189.5	51.20	27.0
Canteen	4	25-30	28.8	2.50	8.7
Duck pot	1	-	60.0	0.00	-
Ladle	21	55-170	111.9	27.50	24.6
Pitcher	3	80-135	103.3	28.43	27.5
Seed jar	1	-	75.0	0.00	-
Tecomate	1	-	85.0	0.00	-
Gourd jar	2	-	45.0	21.21	-
Whiteware jar	4	60-100	72.5	18.93	26.1
Total	195				

Table 2A.20. (continued)

6. Handles

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Type	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Strap	1	11.1	1	10.0	2	20.0	-	-	2	40.0	6	17.1
Tubular	-	-	-	-	1	10.0	-	-	1	20.0	2	5.7
Tubular with perforations	-	-	-	-	-	-	-	-	1	20.0	1	2.9
Trough/gourd	2	22.2	5	50.0	3	30.0	-	-	1	20.0	11	31.4
Nubbin	-	-	-	-	1	10.0	-	-	-	-	1	2.9
Indented	1	11.1	-	-	-	-	-	-	-	-	1	2.9
Strap lug	5	55.6	2	20.0	2	20.0	-	-	-	-	9	25.7
Perforated lug	-	-	2	20.0	-	-	-	-	-	-	2	5.7
Multiple solid coil Strap lug	-	-	-	-	-	-	1	100.0	-	-	1	2.9
Effigy handles	-	-	-	-	1	10.0	-	-	-	-	1	2.9
Totals	9	100.0	10	100.0	10	100.0	1	100.0	5	100.0	35	100.0

7. Surface Alteration

Type	No.	%
Blackened	16	4.1
Fugitive red	1	0.3
Mineral encrusted	5	1.3
Total	22	5.7

Worked Sherds = 41 (10.4%).

Table 2A.20. (continued)

B. PASTE

1. Temper Composition

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Temper	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Undifferentiated sandstone	-	-	204	97.1	-	-	-	-	-	-	204	55.9
Chalcedonic sandstone	-	-	5	2.4	-	-	-	-	-	-	5	1.4
Magnetitic sandstone	-	-	1	0.5	-	-	-	-	-	-	1	0.3
Trachyte	-	-	-	-	28	50.0	-	-	-	-	28	7.7
Sandstone > trachyte	-	-	-	-	9	16.1	-	-	-	-	9	2.5
Trachyte > sandstone	-	-	-	-	19	33.9	-	-	-	-	19	5.2
San Juan igneous with hornblende	18	30.5	-	-	-	-	-	-	-	-	18	4.9
San Juan igneous without hornblende	8	13.6	-	-	-	-	-	-	-	-	8	2.2
San Juan igneous with hornblende	1	1.7	-	-	-	-	-	-	-	-	1	0.3
Sandstone and San Juan igneous with hornblende	2	3.4	-	-	-	-	-	-	-	-	2	0.5
Sandstone igneous and San Juan igneous without hornblende	7	11.9	-	-	-	-	-	-	-	-	7	1.9
San Juan igneous with hornblende and sandstone	7	11.9	-	-	-	-	-	-	-	-	7	1.9
San Juan igneous without hornblende and sandstone	16	27.1	-	-	-	-	-	-	-	-	16	4.4
Hornblende latite	-	-	-	-	-	-	1	20.0	-	-	1	0.3
Sandstone with Socorro							1	20.0	-	-	1	0.3
Socorro and sandstone	-	-	-	-	-	-	3	60.0	-	-	3	0.8
Unidentified igneous	-	-	-	-	-	-	-	-	3	8.6	3	0.8
Sandstone with unidentified igneous	-	-	-	-	-	-	-	-	19	54.3	19	5.2
Unidentified igneous with sandstone	-	-	-	-	-	-	-	-	13	37.1	13	3.6
Totals	59	100.0	210	100.0	56	100.0	5	100.0	35	100.0	365	100.0

Table 2A.20. (continued)

2. Texture Attributes

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Grain Size	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Very fine	21	35.6	63	30.0	24	42.9	3	60.0	28	80.0	139	38.1
Fine	-	-	2	1.0	1	1.8	-	-	-	-	3	0.8
Medium	35	59.3	117	55.7	23	41.1	2	40.0	6	17.1	183	50.1
Coarse	-	-	1	0.5	-	-	-	-	-	-	1	0.3
Very coarse	3	5.1	27	12.9	8	14.3	-	-	1	2.9	39	10.7
Totals	59	100.0	210	100.0	56	100.0	5	100.0	35	100.0	365	100.0

Density	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Temper Density	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
1-2%	-	-	4	2.2	-	-	-	-	-	-	4	1.3
5%	6	12.8	24	13.5	-	-	-	-	8	23.5	38	12.0
10%	18	38.3	65	36.5	19	36.5	1	20.0	8	23.5	111	35.1
20%	19	40.4	65	36.5	24	46.2	2	40.0	15	44.1	125	39.6
30%	4	8.5	15	8.4	8	15.4	2	40.0	3	8.8	32	10.1
>40%	-	-	5	2.8	1	1.9	-	-	-	-	6	1.9
Totals	47	100.0	178	100.0	52	100.0	5	100.0	34	100.0	316	100.0

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Sherd Temper	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
None	29	49.2	17	8.1	22	39.3	2	40.0	3	8.3	73	19.9
< half	17	28.8	50	23.8	20	35.7	2	40.0	16	44.4	105	28.7
> half	13	22.0	129	61.4	13	23.2	1	20.0	13	36.1	169	46.2
All	-	-	14	6.7	1	1.8	-	-	3	8.3	18	4.9
Not observed	-	-	-	-	-	-	-	-	1	2.8	1	0.3
Totals	59	100.0	210	100.0	56	100.0	5	100.0	36	100.0	366	100.0

Table 2A.20. *(continued)*

3. Clay Attributes

	Exotic Mineral Breakdown											
	San Juan		Sandstone		Trachyte		Socorro		Other		Total	
Vitrification	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Absent	26	44.1	44	21.4	16	29.1	-	-	7	20.0	93	25.8
High-fired	20	33.9	64	31.1	26	47.3	3	60.0	17	48.6	130	36.1
Marked	13	22.0	98	47.6	13	23.6	2	40.0	11	31.4	137	38.1
Totals	59	100.0	206	100.0	55	100.0	5	100.0	35	100.0	360	100.0

Pueblo II-Pueblo III (PII-III) Mineral-on-white

Production span: A.D. 850 to 1150

Table: 2A.21

Description:

This type contains items that could not be placed in more specific types due to the portion of the vessel from which they came or to the small size of the sherd. Because of these placement difficulties, this group contains higher percentages of items such as jars and especially ollas with their nondescript neck designs, handles which often exhibit enough paint and finish to place them in Pueblo II or early Pueblo III, but not enough design to place them in a type.

Table 2A.21. Pueblo II-Pueblo III (PII-PIII) Mineral-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	4	0.2	0.8
29SJ 299 PI	8	0.3	3.2
Pueblo Alto	618	25.0	11.5
29SJ 627	1,044	42.3	13.9
29SJ 628	3	0.1	0.3
29SJ 629	381	15.4	22.3
29SJ 633	50	2.0	11.7
29SJ 724	2	0.1	0.4
29SJ 1360	358	14.5	17.1
Total	2,468	100.0	12.4

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%[a]
Hooks, flags	4	-	1	5	0.2
Framed line elements	5	1	-	6	0.3
Unnested isolates	2	-	-	2	0.1
Stars, suns	2	-	-	2	0.1
Non-overlapping steps	2	-	-	2	0.1
Parallel lines	255	21	2	278	12.0
Cribbed parallel lines	17	-	-	17	0.7
Pendant parallel lines	79	8	-	87	3.8
Framers with unticked solids	15	-	-	15	0.6
Framers with ticked solids	5	1	-	6	0.3
Irregular wide lines	10	1	-	11	0.5
Ticking	2	8	-	10	0.4
Corner triangles	4	4	-	8	0.3
Scrolls	35	9	1	45	1.9
Dots	10	1	-	11	0.5
Framing dots	-	1	-	1	0.0
Dotted lines	47	15	-	62	2.7
Thick wavy lines	5	2	-	7	2.7
Dotted checkerboard	1	-	-	1	0.0
Checkerboard	46	1	-	47	2.0
Eyed solids	5	-	-	5	0.2
Sawteeth	76	5	-	81	3.5
Barbs	18	5	-	23	1.0
Elongated scalloped triangles	3	2	-	5	0.2
Wide Sosi style	44	1	-	45	1.9
Narrow Sosi style	41	6	-	47	2.0
Heavy dotted lines	5	-	-	5	0.2
Heavy curvilinear lines	12	-	-	12	0.5
Narrow curvilinear lines	12	-	-	12	0.5
Solid band design	61	4	7	72	3.1
Hatched band design	1	-	-	1	0.0
Isolated triangles	7	-	-	7	0.3

Table 2A.21. (continued)

	Motif No.				
Designs	1	2	3	No.	%[a]
General solids	599	46	1	646	27.9
Hachure A-1	15	2	-	17	0.7
Hachure A-2	3	-	-	3	0.1
Hachure A-3	3	1	-	4	0.2
Hachure B-1	15	-	-	15	0.6
Hachure B-3	6	-	-	6	0.3
Hachure B-4	8	-	-	8	0.3
Hachure B-6	5	2	-	7	0.3
Hachure B-7	4	-	-	4	0.2
Hachure B-C	6	1	-	7	0.3
Hachure C	1	-	-	1	0.0
Hatched checkerboard	3	-	-	3	0.1
Hatched pendants	1	-	-	1	0.0
Squiggle lines	100	3	-	103	4.4
Anthro/zoomorphs	7	3	-	10	0.4
Solid ticked triangles	98	12	1	111	4.8
Exterior bowl motif	8	9	3	20	0.9
White exterior design	-	1	-	1	0.0
Jar neck motif	228	5	1	234	10.1
Interlocking ticking	4	2	-	6	0.3
Other solid	2	-	-	2	0.1
Other hatched	144	14	1	159	6.9
Polished plain	1	-	-	1	0.0
Narrow neckbanding	1	3	-	4	0.2
Wide neckbanding	1	-	-	1	0.0
Narrow clapboard	1	-	-	1	0.0
Narrow corrugated	1	1	2	4	0.2
Totals	2,096	201	20	2317	100.0
No. with 1, 2, 3 treatments	1,895	181	20	2,096	-
% with 1, 2, 3 treatments	90.4	8.6	1.0	-	84.9
No. items with no design coded	-	-	-	371	-
% of total with no design	-	-	-	-	15.0

[a] Percent of designs and surface treatments.

2. Paint

Type		No.	%
Mineral:	red	42	1.7
	brown	578	23.5
	black	1,747	71.1
	green	25	1.0
Carbon		6	0.2
Glaze		30	1.2
Unknown		28	1.1
Total		2,456	100.0

Rim Decoration	No.	%
Unpainted	328	13.3
Solid line	1,156	46.8
Dotted	17	0.7
Eroded, solid line	130	5.3
Use-ground	177	7.2
Unknown	660	26.7
Total	2,468	100.0

Table 2A.21. (continued)

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	271	18.2	153	17.0	424	17.8
None	111	7.5	67	7.5	178	7.5
One side						
Streaky	59	4.0	49	5.5	108	4.5
Moderate	126	8.5	145	16.1	271	11.4
Completely polished	446	30.0	482	53.6	928	38.9
Both sides						
Streaky	12	0.8	-	-	12	0.5
Moderate	42	2.8	-	-	42	1.8
Totals	212	14.2	2	0.2	214	9.0
Differential	209	14.0	1	0.1	210	8.8
Totals	1,488	100.0	899	100.0	2,387	100.0

*Unknown vessel form omitted, n=81.

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	92	6.2	52	5.8	144	6.0
Interior	387	26.0	5	0.6	392	16.4
Exterior	47	3.2	595	66.2	642	26.9
Slipslop	80	5.4	192	21.4	272	11.4
Both sides	694	46.7	4	0.4	698	29.3
Unknown	187	12.6	51	5.7	238	10.0
Totals	1,487	100.0	899	100.0	2,386	100.0

*Unknown vessel forms omitted, n = 81.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	1,221	49.5	658	30-350	177.7	63.829	35.9
Canteen	38	1.5	37	20-120	32.3	16.939	51.4
Ladle	267	10.8	93	40-265	102.8	34.527	33.6
Jar	503	20.4	163	20-205	78.5	26.904	34.3
Olla	205	8.3	188	40-300	76.7	22.599	29.5
Pitcher	79	3.2	55	30-190	89.9	29.791	33.1
Seed jar	14	0.6	12	30-150	67.9	21.155	31.1
Tecomate	14	0.6	12	40-300	88.8	36.202	41.0
Cylinder vessel	1	0.0	1	105	-	-	-
Duck pot	5	0.2	-	-	-	-	-
Mug	1	0.0	1	350*	-	-	-
Pipe	2	0.1	-	-	-	-	-
Effigy	16	0.6	1	70	-	-	-
Miniature	17	0.7	14	20-70	33.6	16.223	48.3
Gourd jar	4	0.2	3	20-60	35.0	-	-
Unknown	81	3.3	-	-	-	-	-
Total	2,468	100.0					

Table 2A.21. (continued)

* Diameter of 350 for a mug indicates either a form or diameter miscode.

6. Handles

Type	No.	%
Solid coil	28	6.6
Multi-coil	36	8.5
Strap	124	29.2
Tubular	39	9.2
Perforated tubular	8	1.9
Trough	108	25.4
Nubbin	3	0.7
Indented	9	2.1
Strap lug	29	6.8
Solid tabular lugs	6	1.4
Cupule lug	5	1.2
Perforated lug	12	2.8
Multi-coil strap	9	2.1
Effigy	8	1.9
Unknown	1	0.2
Total	425	100.0

Handles:items = 1:8
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
Absent	2,402	97.4
Blackening	48	1.9
Fugitive red	8	0.3
Mineral encrustation	7	0.3
Total	2,465	100.0

Worked sherds = 336 (13.6%).

Table 2A.21. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=1,684, 81.0%)		
Fine to medium sandstone > sherd	436	21.0
Fine to medium sandstone < sherd	943	45.4
Coarse sandstone > sherd	102	4.9
Coarse sandstone < sherd	203	9.8
All chalcedonic sandstone*	114	5.5
Sandstone with rounded iron oxide	4	0.2
Magnetitic sandstone	11	0.5
Trachyte	42	2.0
Trachyte > sandstone	101	4.9
Sandstone > trachyte	49	2.4
San Juan igneous with hornblende	8	0.4
Sandstone with San Juan igneous with hornblende > sandstone	6	0.3
Sandstone > San Juan igneous with hornblende	1	0.0
San Juan igneous without hornblende	7	0.3
San Juan igneous without hornblende > sandstone	11	0.5
Sandstone > San Juan igneous without hornblende	8	0.4
Sandstone with Socorro	1	0.0
Unidentified igneous	2	0.1
Unidentified igneous with sandstone	11	0.5
Sandstone with unidentified igneous	18	0.9
Total	2,078	100.0

* Varieties specified: pink, n=56.

2. Texture Attributes

Grain Size	No.	%	Density	No.	%	Sherd Temper	No.	%
Fine	533	25.7	1-2%	17	0.9	None	243	11.7
Medium	1,184	57.0	5%	226	12.5	< half	538	25.9
Coarse	344	16.6	10%	746	41.4	> half	1,225	59.0
Very coarse	16	0.8	20%	643	35.7	All	71	3.4
Total	2,077		30%	139	7.7	Total	2,077	
			>40%	31	1.7			
			Total	1,802				

Table 2A.21. (continued)

Undifferentiated Sandstone Grain Size	No.	%
Fine	402	23.9
Medium	977	58.0
Coarse	290	17.2
Very coarse	15	0.9
Total	1,684	100.0

Texture Index	No.	%
Very fine (0-2)	428	23.8
Fine (2.1-4)	772	42.8
Fine-medium (4.1-7)	407	22.6
Medium (7.1-10)	120	6.7
Medium-coarse (10.1-13)	36	2.0
Coarse (13.1-16)	30	1.7
Very coarse (16.1+)	9	0.5
Total	1,802	100.0

3. Clay Attributes

Vitrification	No.	%
Absent	409	19.8
Present	701	33.9
Marked	956	46.3
Total	2,066	

Unidentified Whitewares

Production span: A.D.

Table: 2A.22

Description:

Items in this group are clearly whitewares, based on their texture and surface treatment, but which lack paint either from erosion or because the sherd came from an unpainted portion of a vessel. There are 186 (16.6 percent) cases with vestiges of paint, 177 of which are mineral paint.

Table 2A.22. Unidentified Whiteware definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	35	3.1	7.0
29SJ 299 PI	19	1.7	7.7
Pueblo Alto	117	10.4	2.2
29SJ 423	61	5.4	9.6
29SJ 627	545	48.5	7.2
29SJ 628	36	3.2	4.2
29SJ 629	101	9.0	5.9
29SJ 633	23	2.0	5.4
29SJ 721	17	1.5	11.8
29SJ 724	28	2.5	5.2
29SJ 1360	135	12.0	6.5
Shabik'eshchee	6	0.5	3.1
Total	1,123	100.0	5.7

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	-	5	-	5	3.0
Framed line elements	1	-	-	1	0.6
Parallel lines	5	1	-	6	3.6
Pendant parallel lines	5	1	-	6	3.6
Framers with unticked solids	2	-	-	2	1.2
Irregular wide lines	1	-	-	1	0.6
Dotted lines	1	-	-	1	0.6
Checkerboard	1	-	-	1	0.6
Sawteeth	1	-	-	1	0.6
Wide Sosi style	1	-	-	1	0.6
Narrow Sosi style	-	1	-	1	0.6
Solid band design	1	-	2	3	1.8
General solids	13	1	3	17	10.1
Hachure B-1	2	-	-	2	1.2
Hachure B-3	1	-	-	1	0.6
Hachure B-C	1	-	-	1	0.6
Squiggle lines	2	-	-	2	1.2
Solid ticked triangles	3	1	-	4	2.4
Exterior bowl motif	-	1	-	1	0.6
White exterior design	1	1	-	2	1.2
Jar neck motif	5	-	-	5	3.0
Others, hatched	6	-	-	6	3.6
Unpolished plain	63	-	-	63	37.3
Polished plain	46	-	-	46	27.2
Undifferentiated banded	2	-	-	2	1.2
Wide neckbanded	1	-	-	1	0.6
Narrow neckbanded	1	-	-	1	0.6
Narrow corrugated	3	-	-	3	1.8
Totals	169	12	5	186	-

Table 2A.22. (continued)

	Motif No.				
Designs	1	2	3	No.	%
No. with 1, 2, 3 treatments	157	7	5	169	-
% with 1, 2, 3 treatments	92.9	4.1	3.0	-	-
No. with no surface treatment	-	-	-	954	-
Percent of total	-	-	-	-	85.0

2. Paint

Type		No.	%
Unpainted		874	77.8
Mineral:	red	10	0.9
	brown	51	4.5
	black	116	10.3
Carbon		9	0.8
Unknown		63	5.6
Total		1,123	100.0

Rim Decoration	No.	%
Unpainted	481	42.8
Solid line	70	6.2
Dotted	1	0.1
Eroded, solid line	35	3.1
Use-ground	45	3.6
Unknown	491	43.7
Total	1,123	100.0

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	179	29.6	149	35.5	328	32.0
None	112	18.5	63	15.0	175	17.1
One side						
Streaky	24	4.0	17	4.0	41	4.0
Completely polished	50	8.3	57	13.6	107	10.4
Total	89	14.7	131	31.2	220	21.5
Both sides						
Streaky	11	1.8	-	-	11	1.1
Moderate	31	5.1	1	0.2	32	3.1
Total	67	11.1	2	0.5	69	6.7
Differential interior/exterior polish	42	6.9	-	-	42	4.1
Totals	605	100.0	420	100.0	1,025	100.0

*Unknown vessel form omitted, n=98.

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	225	37.2	59	14.0	284	27.7
Interior	68	11.2	6	1.4	74	7.2
Exterior	22	3.6	232	55.2	254	24.8
Slipslop	15	2.5	26	6.2	41	4.0
Both sides	123	20.3	1	0.2	124	12.1
Unknown	152	25.1	96	22.9	248	24.2
Totals	605	100.0	420	100.0	1,025	100.0

*Unknown vessel forms omitted, n=98.

Table 2A.22. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	520	46.3	253	40-350	180.8	65.740	36.4
Ladle	85	7.6	34	70-170	96.8	20.482	21.2
Ww Jar	290	25.8	74	25-160	80.9	27.751	28.7
Olla	53	4.7	43	50-120	77.6	13.200	17.0
Pitcher	32	2.8	17	45-480	90.9	30.885	34.0
Tecomate	14	1.2	11	40-205	111.4	51.239	46.0
Seed jar	6	0.5	5	25-110	69.0	33.241	48.2
Canteen	13	1.2	13	20-55	31.2	8.697	27.9
Duck pot	2	0.2	-	-	-	-	-
Effigy	4	0.4	1	80	-	-	-
Miniature	5	0.4	4	20-35	26.2	-	-
Gourd jar	1	0.1	1	30	-	-	-
Unknown	98	8.7					
Total	1,123	100.0					

6. Handles

Type	No.	%
Solid coil	38	18.2
Multi-coil	25	12.0
Strap	49	23.4
Tubular	28	13.4
Perforated tubular	3	1.4
Trough-gourd	27	12.9
Nubbin	1	0.5
Indented	7	3.3
Strap lug	16	7.7
Solid tabular lugs	1	0.5
Cupule lug	1	0.5
Curved or sagging nubbin	1	0.5
Perforated lug	6	2.9
Multiple solid coil	5	2.4
Effigy handles	1	0.5
Total	209	

Handles:items = 1:6
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
Sooted	1	0.1
Absent	1,034	92.3
Blackened	31	2.8
Fugitive red	52	4.6
Mineral encrustation	2	0.2
Total	1,120	100.0

Worked sherds = 271 (24.1%).

Table 2A.22. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=758, 78.7%)		
Fine to medium sandstone > sherd	175	18.2
Fine to medium sandstone < sherd	340	35.3
Coarse sandstone > sherd	174	18.1
Coarse sandstone < sherd	69	7.2
All chalcedonic sandstone	35	3.6
Sandstone with rounded iron oxide	20	2.1
Magnetitic sandstone	8	0.8
Trachyte	57	5.9
Trachyte > sandstone	40	4.2
Sandstone > trachyte	9	0.9
San Juan igneous with hornblende	14	1.5
San Juan igneous with hornblende with sandstone	6	0.6
San Juan igneous without hornblende	7	0.7
San Juan igneous withithout horneblende with sandstone	5	0.5
Unidentified igneous	2	0.2
Sandstone with unidentified igneous		20.2
Total	963	

Varieties specified: pink, n=25.

2. Texture Attributes

Grain Size	No.	%
Fine	208	21.6
Medium	442	45.9
Coarse	271	28.0
Very coarse	42	4.4
Total	963	

Density	No.	%
1-2%	11	1.5
5%	103	14.0
10%	296	40.3
20%	257	35.0
30%	62	8.4
>40%	6	0.8
Total	735	

Sherd Temper	No.	%
None	335	34.8
< half	165	17.2
> half	422	43.9
All	40	4.2
Total	962	

Undifferentiated Sandstone Grain Size	No.	%
Fine	162	21.4
Medium	353	46.6
Coarse	212	28.0
Very coarse	31	4.1
Total	758	100.0

Texture Index	No.	%
Very fine (0-2)	163	22.2
Fine (2.1-4)	212	28.9
Fine-medium (4.1-7)	158	21.5
Medium (7.1-10)	70	9.5
Medium-coarse (10.1-13)	35	4.8
Coarse (13.1-16)	59	8.0
Very coarse (16.1+)	37	5.0
Total	734	100.0

Table 2A.22. *(continued)*

3. Clay Attributes

Vitrification	No.	%
Absent	319	35.4
Present	216	23.9
Marked	367	40.7
Total	902	

WHITEWARES

Carbon-on-white Types

Unpolished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white

References: Breternitz et al. (1974); Colton and Hargrave (1937)

Synonyms:

Lino Black-on-gray
Mesa Verde: Chapin Black-on-white with carbon paint (8.1 percent)
Chuska Carbon: Theodore Black-on-white (4.0 percent)
Tusayan: Lino Black-on-gray

Similar types:

Cibola: La Plata Black-on-white, Unpolished Basketmaker III-Pueblo I Mineral-on-white
Chuska Mineral: Crozier Black-on-white
San Juan: Chapin Black-on-white

Production span: A.D. 550 to 875

Table: 2A.23

Description:

These earliest decorated vessels make frequent use of parallel lines, z's, flags on the ends of lines, and especially dots. There are often substantial areas left undecorated; sometimes one or two elaborated anthropomorphic figures are present. Most vessels in this type are bowls; painted closed forms are rare. In contrast to the Basketmaker III-Pueblo I Mineral-on-white types, unpainted rims are more abundant than rims with solid painted lines. Fugitive red occurs on half of the vessels in this sample, more than in any other type (Table 2.17B).

The unpolished group contains predominantly coarse sandstone temper, with only a few trachyte-tempered items and a few more San Juan igneous tempered specimens. Magnetitic sandstone and iron oxide-bearing sandstone are more common in this type than in later ones, suggesting more local manufacture.

Table 2A.23. Unpolished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	1	1.0	0.2
29SJ 299 PI	2	2.0	0.8
Pueblo Alto	-	-	-
29SJ 423	-	-	-
29SJ 627	16	16.2	0.2
29SJ 628	68	68.7	7.9
29SJ 629	5	5.1	0.3
29SJ 633	-	-	-
29SJ 721	-	-	-
29SJ 724	6	6.1	1.1
29SJ 1360	1	1.0	0.05
Shabik'eshchee	-	-	-
Total	99	100.1	0.5

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Isolated single elements	2	1	-	3	3.4
Hooks, flags	9	3	-	12	13.5
Nonoverlapping steps	1	-	1	2	2.2
Parallel lines	15	2	-	17	19.1
Framers with unticked solids	3	-	-	3	3.4
Ticking	5	2	-	7	7.9
Dots	24	1	-	25	28.1
Other framed isolates	2	-	-	2	2.2
Dotted lines	3	1	-	4	4.5
Sawteeth	1	2	-	3	3.4
Barbs	1	-	-	1	1.1
Wide Sosi style	1	-	-	1	1.1
Heavy dotted lines	-	1	-	1	1.1
General solids	4	-	1	5	5.6
Exterior bowl motif	1	-	-	1	1.1
Narrow Sosi Style	1	-	-	1	1.1
Other, hachure	1	-	-	1	1.1
Totals	74	13	2	89	99.9
No. with 1, 2, 3 treatments	61	11	2	74	-
% with 1, 2, 3 treatments	82.4	14.9	2.7	-	100.0

Type Design Diversity H' = 2.260
s = 17 J = 0.798
Design Distribution Diversity H' = 0.520
s = 3 J = 0.473

Table 2A.23. (continued)

2. Paint

Type		No.	%
Mineral:	brown	1	1.0
	black	3	3.1
Carbon		94	95.9
Total		98	100.0

Rim Decoration	No.	%
Unpainted	23	23.2
Solid line	16	16.2
Eroded with paint	1	1.0
Use-ground	1	1.0
Unknown	58	58.6
Total	99	100.0

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	1	1.1	-	-	1	1.0
None	89	96.7	3	50.0	92	93.9
One side						
Streaky	-	-	1	16.7	1	1.0
Moderate	-	-	-	-	-	-
Completely polished	1	1.1	2	33.3	3	3.1
Both sides						
Streaky	-	-	-	-	-	-
Moderate	-	-	-	-	-	-
Completely polished	1	1.1	-	-	1	1.0
Differential interior/exterior polish	-	-	-	-	-	-
Totals	92	93.9	6	6.1	98	100.0

* Unknown vessel forms omitted, n=1.

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	89	96.7	3	50.0	92	93.9
Interior	1	1.1	-	-	1	1.0
Exterior	-	-	3	50.0	3	3.1
Slipslop	-	-	-	-	-	-
Both sides	2	2.2	-	-	2	2.0
Unknown	-	-	-	-	-	-
Totals	92	93.9	6	6.1	98	100.0

*Unknown vessel forms omitted, n=1.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	92	92.9	34	100-265	162.5	37.764	23.2
Jar	6	6.1	2	35- 70	52.5	24.749	47.1
Unknown	1	1.0					
Total	99	100.0					

Diversity of Forms $H' = 0.230$
$s = 2$ $J = 0.332$

6. Handles

Type	No.	%
Solid coil	1	100.0

Table 2A.23. (continued)

7. Surface Alteration

Type	No.	%
None	48	49.5
Fugitive red	49	50.5
Total	97	100.0

Worked sherds = 1 (1.0%).

8. Design by Vessel Forms

Designs	Bowl	Jar	Total
Isolated single elements	3	-	3
Hooks, flags	12	-	12
Nonoverlapping steps	2	-	2
Parallel lines	16	1	17
Framers with unticked solid	2	1	3
Ticking	7	-	7
Dots	25	-	25
Other framed isolates	2	-	2
Dotted lines	2	2	4
Sawteeth	3	-	3
Barbs	-	1	1
Wide Sosi style	1	-	1
Heavy dotted lines	1	-	1
General solids	4	1	5
Narrow Sosi style	1	-	1
Others, hatched	1	-	1
Total of designs	82	6	88
% of designs	93.2	6.8	-
Total of vessels	92	6	98
% of vessels	93.9	6.1	-

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=76, 76.8%)		
Fine to medium sandstone sherd	7	7.1
Coarse sandstone sherd	69	60.9
Sandstone with rounded iron oxide	9	9.1
Magnetitic sandstone	2	2.0
Trachyte	3	3.0
Trachyte > sandstone	1	1.0
San Juan igneous with hornblende	8	8.1
Total	99	100.0

Temper Diversity H' = 0.855
s = 6 J = 0.477

Table 2A.23. (continued)

2. Texture Attributes

Grain Size	No.	%
Fine	-	-
Medium	11	11.1
Coarse	72	72.7
Very coarse	16	16.2
Total	99	100.0

Density	No.	%
1-2%	-	-
5%	1	5.5
10%	9	50.0
20%	5	27.8
30%	3	16.7
> 40%	-	-
Total	18	100.0

Sherd Temper	No.	%
None	94	94.9
< half	5	5.1
> half	-	-
All	-	-
Total	99	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	-	-
Medium	7	9.2
Coarse	55	72.4
Very coarse	14	18.4
Total	76	100.0

Texture Index	No.	%
Very fine (0-2)	-	-
Fine (2.1-4)	-	-
Fine-medium (4.1-7)	1	5.5
Medium (7.1-10)	3	16.7
Medium-coarse (10.1-13)	2	11.1
Coarse (13.1-16)	5	27.8
Very coarse (16.1+)	7	38.9
Total	18	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	10	50.0
Gray with black and white	3	15.0
Chuska gray, homogeneous	3	15.0
Tan to brown clay	1	5.0
White clay	3	15.0
Total	20	100.0

Vitrification	No.	%
Absent	15	55.6
Present	5	18.5
Marked	7	25.9
Total	27	100.0

Paste Diversity $H' = 1.350$

$s = 5$ $J = 0.839$

Polished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white

References: Breternitz et al. (1974); Goetze and Mills (1993); Windes (1977)

Synonyms:

Kana'a Black-on-white
Chuska Carbon: Theodore, Peña Black-on-white (26.1 percent)
Tusayan: Kana'a Black-on-white
Mesa Verde: Piedra Black-on-white with organic paint (4.9 percent)

Similar types:

Cibola: White Mound, Kiatuthlanna Black-on-whites
Mesa Verde: Piedra Black-on-white
Chuska Mineral: Crozier Black-on-white

Production span: A.D. 800 to 900

Table: 2A.24

Description:

Although considerable overlap is likely between this group and the unpolished group, polished specimens increase through time. Line execution is on the whole better in the polished group, and designs fill the field more fully. This type has a much larger inventory of motifs (31 as opposed to 17); the sample of this type is larger than that of unpolished, but this seems an especially dramatic increase. Dots are less heavily used in the polished group than the unpolished. Fugitive red is present on a third of the vessels in this sample, compared to half of the unpolished carbon and less than 20 percent of unpolished mineral-on-white of comparable age.

This group contains the first substantial occurrence of trachyte temper—25 percent in the polished group as opposed to only 4 percent in the unpolished carbon-on-white group. San Juan igneous temper is still present but as a smaller percentage (5 percent). Closed forms are also more abundant in polished as opposed to unpolished Basketmaker III-Pueblo I Carbon-on-white.

Table 2A.24. Polished Basketmaker III-Pueblo I (BMIII-PI) Carbon-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	3	1.6	0.6
29SJ 299 PI	2	1.1	0.8
Pueblo Alto	1	0.5	0.02
29SJ 423	3	1.6	0.5
29SJ 627	33	17.5	0.4
29SJ 628	75	39.7	8.7
29SJ 629	30	15.9	1.8
29SJ 633	2	1.1	0.6
29SJ 721	2	1.1	1.4
29SJ 724	15	7.9	2.8
29SJ 1360	22	11.6	1.1
Shabik'eshchee	1	1.1	0.5
Total	189	100.7	0.9

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Isolated single elements	2	3	1	6	2.6
Hooks, flags	16	6	-	22	9.6
Nested isolates	2	1	-	3	1.3
Nonoverlapping steps	6	-	2	8	3.4
Parallel lines	44	5	-	49	21.3
Cribbed parallel lines	1	-	-	1	0.4
Pendant parallel lines	3	-	-	3	1.3
Framers with unticked solids	12	1	-	13	5.7
Framers with ticked solids	5	-	-	5	2.2
Irregular wide lines	2	-	-	2	0.9
Ticking	5	11	3	19	8.3
Corner triangles	2	2	-	4	1.7
Scrolls	1	-	-	1	0.4
Framed slashes	1	-	-	1	0.4
Dots	14	3	1	18	7.8
Other framed isolates	6	-	-	6	2.6
Framing dots	1	1	-	2	0.9
Dotted lines	5	2	-	7	3.0
Sawteeth	6	3	-	9	3.9
Barbs	2	1	-	3	1.3
Heavy dotted lines	1	-	-	1	0.4
Solid band design	5	-	-	5	2.2
General solids	16	8	1	25	10.9
Hachure A-1	-	2	-	2	0.9
Hatched checkerboard	1	-	-	1	0.4
Squiggle lines	2	1	-	3	1.3
Solid ticked triangles	2	-	1	3	1.3
Exterior bowl motif	-	1	-	1	0.4
Narrow Sosi style	4	1	-	5	2.2

Table 2A.24. (continued)

	Motif No.				
Designs	1	2	3	No.	%
Others, hachure	1	-	-	1	0.4
Narrow corrugated 2-5 mm	1	-	-	1	0.4
Totals	69	52	9	230	99.8
No. with 1, 2, 3 treatments	117	43	9	169	99.9
% with 1, 2, 3 treatments	69.2	25.4	5.3	-	100.0

Type Design Diversity H' = 2.819
s = 31 J = 0.821
Design Distribution Diversity H' = 0.689
s = 3 J = 0.628

2. Paint

Type	No.	%
Mineral: brown	1	0.5
black	1	0.5
Mineral-carbon	1	0.5
Carbon	184	98.4
Total	187	99.9

Rim Decoration	No.	%
Unpainted	41	21.7
Solid line	30	15.9
Dotted	1	0.5
Eroded, solid line	3	1.6
Use-ground	5	2.6
Unknown	109	57.7
Total	189	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	4	2.6	3	8.1	7	3.7
None	5	3.3	1	2.7	6	3.2
One side						
Streaky	20	13.2	1	2.7	21	11.1
Moderate	56	36.8	4	10.8	60	31.7
Completely polished	35	23.0	28	75.7	63	33.3
Both sides						
Streaky	-	-	-	-	-	-
Moderate	4	2.6	-	-	4	2.6
Completely polished	17	11.2	-	-	17	9.0
Differential interior/exterior polish	11	7.2	-	-	11	5.8
Totals	152	80.4	37	19.6	189	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	100	65.8	13	35.1	113	59.8
Interior	25	16.4	-	-	25	13.2
Exterior	-	-	18	48.6	18	9.5
Slipslop	1	0.7	5	13.5	6	3.2
Both sides	23	15.1	-	-	23	12.2
Unknown	3	2.0	1	2.7	4	2.1
Totals	152	80.4	37	19.6	189	100.0

Table 2A.24. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	149	78.8	45	70-270	168.0	46.836	27.9
Ladle	3	1.6	2	60-110	85.0	35.355	41.6
Jar	29	15.3	5	50- 75	65.0	10.000	15.4
Pitcher	6	3.2	4	60-140	82.5	38.622	46.8
Effigy	1	0.5	-	-	-	-	-
Gourd jar	1	0.5	1	85	-	-	-
Total	189	99.9					

Diversity of Forms H' = 0.706
s = 6 J = 0.394

6. Handles

Type	No.	%
Strap	1	25.0
Trough	1	25.0
Strap lug	1	25.0
Perforated nubbin lug	1	25.0
Total	4	100.0

Handles:items = 1:47
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
None	121	64.0
Blackening	4	2.1
Fugitive red	64	33.9
Total	189	100.0

Worked Sherds = 5 (2.6%).

Table 2A.24. *(continued)*

8. Vessel Forms by Designs

Designs	Bowl	Ladle	Pitcher	Gourd Jar	Effigy	Jar	Total
Isolated single elements	6	-	-	-	-	-	6
Hooks, flags	19	-	-	1	-	2	22
Nested isolates	3	-	-	-	-	-	3
Nonoverlapping steps	6	-	-	-	-	2	8
Parallel lines	35	2	1	-	-	11	49
Cribbed parallel lines	1	-	-	-	-	-	1
Pendant parallel lines	2	1	-	-	-	-	3
Framers with unticked solids	4	-	5	-	-	4	13
Framers with ticked solids	2	-	-	-	-	3	5
Irregular wide lines	2	-	-	-	-	-	2
Ticking	18	-	-	-	-	1	19
Corner triangles	4	-	-	-	-	-	4
Scrolls	1	-	-	-	-	-	1
Framed slashes	1	-	-	-	-	-	1
Dots	17	-	-	-	-	1	18
Other framed isolates	6	-	-	-	-	-	6
Framing dots	2	-	-	-	-	-	2
Dotted lines	7	-	-	-	-	-	7
Sawteeth	8	-	-	-	-	1	9
Barbs	3	-	-	-	-	-	3
Heavy dotted lines	1	-	-	-	-	-	1
Solid band design	3	-	-	1	-	1	5
General solids	20	-	-	-	-	5	25
Hachure A-1	1	-	-	-	-	1	2
Hatched checkerboard	-	-	-	-	-	1	1
Squiggle lines	2	-	-	-	1	-	3
Solid ticked triangles	1	-	-	-	-	2	3
Bowl exterior motif	1	-	-	-	-	-	1
Narrow Sosi style	5	-	-	-	-	-	5
Other, hachure	-	-	-	-	-	1	1
Narrow corrugated 2-5 mm	-	-	-	-	-	1	1
Total of designs	181	3	6	2	1	37	230
% of designs	78.7	1.3	2.6	0.9	0.4	16.1	-
Total vessels	149	3	6	1	1	29	189
% of vessels	78.8	1.6	3.2	0.5	0.5	15.3	-

Table 2A.24. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=112, 60.9%)		
Fine to medium sandstone > half sherd	13	7.1
Fine to medium sandstone < half sherd	1	0.5
Coarse sandstone > half sherd	96	52.2
Coarse sandstone < sherd	2	1.1
All chalcedonic sandstone*	2	1.1
Tusayan sandstone	1	0.5
Sandstone with rounded iron oxide	9	4.9
Magnetitic sandstone	3	1.6
Trachyte	40	21.7
Trachyte > sandstone	8	4.4
San Juan igneous with hornblende	5	2.7
Sandstone with San Juan igneous	1	0.5
San Juan igneous without hornblende	1	0.5
San Juan igneous with sandstone	1	0.5
Sandstone with San Juan igneous without hornblende	1	0.5
Total	184	99.8

*Varieties specified: pink n = 2

Temper Diversity H' = 1.274
s = 12 J = 0.513

2. Texture Attributes

Grain Size	No.	%
Fine	11	6.0
Medium	37	20.1
Coarse	112	60.9
Very coarse	24	13.0
Total	184	100.0

Density	No.	%
1-2%	2	2.4
5%	8	9.5
10%	34	40.5
20%	28	33.3
30%	10	11.9
> 40%	2	2.4
Total	84	100.0

Sherd Temper	No.	%
None	167	90.8
< half	12	6.5
> half	5	2.7
All	-	-
Total	184	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	1	1.0
Medium	13	11.6
Coarse	82	73.2
Very coarse	16	14.3
Total	112	100.1

Texture Index	No.	%
Very fine (0-2)	2	2.5
Fine (2.1-4)	4	5.0
Fine-medium (4.1-7)	11	13.8
Medium (7.1-10)	14	17.5
Medium-coarse (10.1-13)	12	15.0
Coarse (13.1-16)	19	23.8
Very coarse (16.1+)	18	22.5
Total	80	100.1

Table 2A.24. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	39	44.5
Black with white sherd	4	4.6
Gray with black and white	2	2.3
Gray with white sherd	1	1.1
Chuska gray homogeneous	22	25.0
Tan to brown clay	4	4.6
Black clay	1	1.1
White clay	15	17.0
Total	88	100.0

Vitrification	No.	%
Absent	40	40.0
Present	39	39.0
Marked	21	21.0
Total	100	99.9

Paste Diversity H' = 1.476
s = 8 J = 0.711

Pueblo II-Pueblo III (PII-PIII) Carbon-on-white

References: Breternitz et al. (1974); Franklin (1982:17-19); Toll and McKenna (1987:58-60)

Synonyms:

Cibola Carbon (Franklin 1982)
Chuska Carbon: Nava and Toadlena Black-on-whites (15.8 percent)
Mesa Verde: McElmo Black-on-white (9.2 percent)
Tusayan: Sosi, Dogoszhi, Flagstaff Black-on-whites
Little Colorado Whiteware: Holbrook Black-on-white

Production span: ca. A.D. 1075 to 1300

Table: 2A.25

Description:

This group is something of a catchall for later carbon-painted sherds that could not be placed in tighter groups such as Chaco McElmo or Mesa Verde Black-on-white, but also contains items that are likely to have been produced in the Chaco area after the shift to using carbon paint around A.D. 1100: Franklin's Cibola Carbon. Sites with late components—Pueblo Alto, 29SJ 627, 29SJ 633, 29SJ 629—account for almost all of the sherds in this type. As is true of other later carbon-painted types, hachure designs are rare, and more of those that are present are Hachure A (common in Red Mesa Black-on-white), rather than the Hachure B varieties found in Gallup Black-on-white. Line work tends to be in bold, wide lines with common elements being parallel lines, scrolls, sawteeth, and triangles. Sosi layouts are more common than banded layouts.

Around half of the items in Pueblo II-III Carbon-on-white are predominantly sand-tempered and a majority of that temper probably represents San Juan Basin production. The sand-tempered items could also include vessels from north of the San Juan River, Tusayan vessels, and Little Colorado vessels. Igneous tempers (trachyte, San Juan, unidentified respectively), representing vessels from outside Chaco Canyon and the central San Juan Basin, account for over 40 percent of this type. Perhaps in keeping with its high long distance component, closed forms are infrequent in this type.

Table 2A.25. Pueblo II-Pueblo III (PII-PIII) Carbon-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	2	0.9	0.4
29SJ 299 PI	2	0.9	0.8
Pueblo Alto	98	41.7	1.8
29SJ 423	-	-	-
29SJ 627	71	30.2	0.9
29SJ 628	1	0.4	0.1
29SJ 629	12	5.1	0.7
29SJ 633	42	17.9	13.2
29SJ 721	2	0.9	1.4
29SJ 724	-	-	-
29SJ 1360	5	2.1	0.2
Shabik'eshchee	-	-	-
Total	235	100.1	1.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	2	-	-	2	0.7
Stars, suns	1	-	-	1	0.3
Parallel lines	30	6	-	36	12.8
Cribbed parallel lines	3	-	-	3	1.1
Banded framers	4	-	-	4	1.4
Pendant parallel lines	4	4	-	8	2.8
Framers with unticked solids	2	-	-	2	0.7
Irregular wide lines	-	2	-	2	0.7
Ticking	1	1	-	2	0.7
Corner triangles	1	-	-	1	0.3
Scrolls	5	6	1	12	4.3
Dots	2	1	-	3	1.1
Framing dots	-	2	-	2	0.7
Linear dots	1	-	-	1	0.3
Dotted lines	5	2	-	7	2.5
Thick wavy lines	1	-	-	1	0.3
Dots in parallelograms	1	-	-	1	0.3
Dotted checkerboard	-	1	-	1	0.3
Checkerboard	6	1	-	7	2.5
Eyed solids	3	-	1	4	1.4
Sawteeth	7	2	2	11	3.9
Barbs	6	2	-	8	2.8
Wide Sosi style	28	4	-	32	11.3
Narrow Sosi style	8	1	-	9	3.2
Heavy dotted lines	-	3	-	3	1.1
Heavy curvilinear lines	4	1	1	6	2.1
Narrow curvilinear lines	1	-	-	1	0.3
Solid band design	19	2	1	22	7.8
General solids	45	3	2	50	17.7

Table 2A.25. (continued)

	Motif No.				
Designs	1	2	3	No.	%
Hachure A-1	3	-	-	3	1.1
Hachure A-2	1	-	-	1	0.4*
Hachure A-3	4	-	1	5	1.8
Hachure B-1	3	-	-	3	1.1
Hachure B-3	1	-	-	1	0.3
Hachure B-6	1	-	-	1	0.3
Counterchange	1	-	-	1	0.3
Hatched pendants	2	-	-	2	0.7
Squiggle lines	3	-	-	3	1.1
Anthro/zoomorphs	-	1	-	1	0.3
Solid ticked triangles	3	4	-	7	2.5
Exterior bowl motif	2	2	-	4	1.4
Jar neck motif	3	-	-	3	1.1
Others, hachure	4	1	-	5	1.8
Totals	221	52	9	282	99.5
No. with 1, 2, 3 treatments	169	43	9	221	-
% with 1, 2, 3 treatments	76.5	19.4	4.1	-	100.0

*Unknown vessel form omitted, n=3

Type Design Diversity H' = 3.059
s = 43 J = 0.813
Design Distribution Diversity H' = 0.613
s = 3 J = 0.558

2. Paint

Type		No.	%
Mineral:	brown	2	0.9
	black	4	1.7
	glaze	1	0.4
Mineral-carbon		1	0.4
Carbon		226	96.6
Total		234	100.0

Rim Decoration	No.	%
Unpainted	91	38.7
Solid line	33	14.0
Dotted	45	19.2
Eroded, solid line	4	1.7
Use-ground	15	6.4
Unknown	47	20.0
Total	235	100.0

3. Polish*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	17	9.1	2	4.4	19	8.2
None	6	3.2	1	2.2	7	3.0
One side						
Streaky	3	1.6	2	4.4	5	2.2
Moderate	7	3.7	3	6.7	10	4.3
Completely polished	35	18.7	37	82.2	72	31.0
Both sides						
Streaky	-	-	-	-	-	-
Moderate	1	0.5	-	-	1	0.4
Completely polished	94	50.3	-	-	94	40.5
Differential interior/exterior polish	24	12.8	-	-	24	10.3
Totals	187	80.6	45	19.4	232	99.9

*Unknown vessel form omitted, n=3.

Table 2A.25. (continued)

4. Slip*

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	14	7.5	1	2.2	15	6.5
Interior	34	18.2	-	-	34	14.7
Exterior	-	-	37	82.2	37	15.9
Slipslop	6	3.2	4	8.9	10	4.3
Both sides	122	65.2	-	-	122	52.6
Unknown	11	5.9	3	6.7	14	6.0
Totals	187	80.6	45	19.4	232	100.0

*Unknown vessel forms omitted, n = 3.

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	168	71.5	129	18-350	188.1	61.322	32.6
Ladle	19	8.1	9	40-160	103.3	34.731	33.6
Jar	24	10.2	7	20-135	75.7	40.645	52.9
Olla	8	3.4	6	30- 90	69.2	22.454	32.5
Pitcher	6	2.5	3	40- 90	63.3	25.166	39.7
Canteen	4	1.7	4	30- 40	35.0	5.773	16.5
Effigy	1	0.4	-	-	-	-	-
Miniature	2	0.9	2	20- 40	30.0	14.142	47.1
Unknown	3	1.3					
Total	235	100.0					

Diversity of Forms H' = 1.018
s = 8 J = 0.490

6. Handles

Type	No.	%
Solid coil	1	4.4
Multi-coil	3	13.0
Strap	5	21.7
Tubular	4	17.4
Perforated tubular	1	4.4
Trough	5	21.7
Strap lug	2	8.7
Perforated nubbin lug	2	8.7
Total	66	99.9

Handles:items = 1:10
(Excluding ladles from forms and handles)

7. Surface Alteration

Type	No.	%
One	224	96.6
Blackening	6	2.6
Fugitive red	1	0.4
Mineral encrustation	1	0.4
Total	232	100.0

Worked sherds = 22 (9.4%).

Table 2A.25. (continued)

8. Designs by Vessel Form

Designs	Bowl	Ladle	Canteen	Pitcher	Miniature	Olla	Jar	Total
Hooks, flags	2	-	-	-	-	-	-	2
Stars, suns	-	-	-	-	-	1	-	1
Parallel lines	28	3	-	1	-	1	2	35
Cribbed parallel lines	2	-	-	-	1	-	-	3
Banded framers	3	-	-	-	-	-	1	4
Pendant parallel lines	6	1	-	-	-	1	-	8
Framers with unticked solid	-	1	-	-	-	-	1	2
Irregular wide lines	2	-	-	-	-	-	-	2
Ticking	-	1	-	-	-	-	1	2
Corner triangles	-	-	-	-	-	-	1	1
Scrolls	8	3	-	1	-	-	-	12
Dots	2	-	-	-	-	-	1	3
Framing dots	2	-	-	-	-	-	-	2
Linear dots	-	-	-	-	1	-	-	1
Dotted lines	6	-	-	1	-	-	-	7
Thick wavy lines	1	-	-	-	-	-	-	1
Dots in parallelograms	-	-	-	-	-	-	1	1
Dotted checkerboard	1	-	-	-	-	-	-	1
Checkerboard	6	-	1	-	-	-	-	7
Eyed solids	3	1	-	-	-	-	-	4
Sawteeth	9	-	-	-	-	-	1	10
Barbs	5	1	-	-	-	1	1	8
Wide Sosi style	24	3	-	1	-	-	4	32
Heavy dotted lines	3	-	-	-	-	-	-	3
Heavy curvilinear line	4	1	-	-	-	-	1	6
Solid band design	19	-	-	2	-	1	-	22
General solids	42	3	1	-	-	-	4	50
Hachure A-1	1	-	1	-	-	-	1	3
Hachure A-2	-	1	-	-	-	-	-	1
Hachure A-3	2	-	-	-	-	1	2	5
Hachure B-1	2	-	-	-	-	-	1	3
Hachure B-3	1	-	-	-	-	-	-	1
Hachure B-6	1	-	-	-	-	-	-	1
Counterchange	-	-	-	-	-	-	1	1
Hatched pendants	2	-	-	-	-	-	-	2
Squiggle lines	1	1	-	1	-	-	-	3
Anthro/zoomorphs	-	-	-	-	-	-	1	1
Solid ticked triangles	5	1	-	-	-	-	1	7
Bowl exterior motif	3	1	-	-	-	-	-	4
Jar neck motif	-	-	-	-	-	3	-	3
Narrow Sosi style	7	1	-	-	-	-	1	9
Narrow curvilinear	-	1	-	-	-	-	-	1
Others, hachure	4	-	-	1	-	-	-	5
Total of design	207	24	3	8	2	9	27	280
% of design	73.9	8.6	1.1	2.9	0.7	3.2	9.6	-
Total of vessels	168	19	4	6	2	8	24	231
% of vessels	72.7	8.2	1.7	2.6	0.9	3.5	10.4	-

Table 2A.25. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=119, 52.2%)		
Fine to medium sandstone > sherd	39	17.1
Fine to medium sandstone < sherd	53	23.2
Coarse sandstone > sherd	8	3.5
Coarse sandstone < sherd	19	8.3
Trachyte	24	10.5
Trachyte > sandstone	40	17.5
Sandstone > trachyte	12	5.3
San Juan igneous with hornblende	4	1.8
Sandstone with San Juan igneous with hornblende	4	1.8
San Juan igneous without hornblende	7	3.1
San Juan igneous with sandstone	5	2.2
Unidentified igneous with sandstone	5	2.2
Sandstone with unidentified igneous	7	3.1
Sandstone with ground andesite	1	0.4
Total	228	100.1

Temper Diversity H' = 1.584
s = 11 J = 0.660

2. Texture Attributes

Grain Size	No.	%
Fine	83	36.4
Medium	103	45.2
Coarse	41	18.0
Very coarse	1	0.4
Total	228	100.0

Density	No.	%
1-2%	-	-
5%	23	11.3
10%	76	37.2
20%	85	41.7
30%	17	8.3
>40%	3	1.5
Total	204	100.0

Sherd Temper	No.	%
None	67	29.4
< half	55	24.1
> half	95	41.7
All	11	4.8
Total	228	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	47	39.5
Medium	45	37.8
Coarse	26	21.8
Very coarse	1	0.8
Total	119	99.9

Texture Index	No.	%
Very fine (0-2)	59	28.9
Fine (2.1-4)	51	25.0
Fine-medium (4.1-7)	54	26.5
Medium (7.1-10)	15	7.4
Medium-coarse (10.1-13)	16	7.8
Coarse (13.1-16)	6	2.9
Very coarse (16.1+)	3	1.5
Total	204	100.0

Table 2A.25. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	97	51.3
Gray with black sherd	8	4.2
Gray with black and white	9	4.8
Gray with white sherd	41	21.7
Little Colorado gray	2	1.0
Chuska gray homogeneous	10	5.3
Tan to brown clay	10	5.3
Black clay	5	2.7
White clay	7	3.7
Total	189	100.0

Vitrification	No.	%
Absent	46	20.8
Present	118	53.4
Marked	57	25.8
Total	221	100.0

Paste Diversity H' = 1.530
s = 9 J = 0.696

Chaco McElmo Black-on-white

References: Franklin and Ford (1982); Roberts (1927); Windes (1984b, 1985)

Windes (1985) gives a full discussion of the background of this type, as well as a detailed description with illustrations. In discussing the pottery from Kin Kletso, Vivian and Mathews (1965) subsume all carbon-painted sherds of all wares under "McElmo Black-on-white."

Synonyms:

Chaco-San Juan (Roberts 1927)

Similar types:

Cibola Carbon (Franklin 1982)
Chuska Carbon: Especially Nava, also Toadlena Black-on-white
Mesa Verde: McElmo Black-on-white
Tusayan: Black Mesa and Sosi Black-on-whites

Windes (1985:22) notes the occurrence of mineral-painted sherds that are similar in all other regards to Chaco McElmo Black-on-white; in this analysis such sherds would have been classified as Puerco Black-on-white on the basis of paint type.

Production span: A.D. 1100 to 1150

Table: 2A.26

Description:

Produced beginning around A.D. 1100, proveniences containing Chaco McElmo Black-on-white are relatively few in the Chaco Project sample. They include the fills of Kivas 10 and 16 at Pueblo Alto, the Plaza Structure at Pueblo Alto, and Kiva 1 at 29SJ 629. Excavations in early twelfth century contexts at Pueblo del Arroyo (Windes 1985), Kin Kletso (Vivian and Mathews 1965), and Bis sa'ani (Ford 1982; Franklin 1982; Franklin and Ford 1982) encountered this type in much larger numbers.

Chaco McElmo Black-on-white is the only official member of the Chaco Cibola series that uses carbon paint. Carbon paint is a fundamental criterion for identification of this type, but not all non-Chuskan, Pueblo II-III, carbon-painted sherds fall into it. Chaco McElmo Black-on-white vessels have thin, hard walls, good polish, and well-executed designs. Franklin's (1982) Cibola Carbon and some of the specimens called Pueblo II-III Carbon-on-white in this analysis include less well made and decorated vessels. The design and execution of Chaco McElmo Black-on-white show considerable affinity to Mesa Verde Black-on-white, but Mesa Verde Black-on-white has thicker walls and slipping, and more consistently squared and ticked rims. Chaco McElmo Black-on-white is found in contexts completely devoid of Mesa Verde Black-on-white, and clearly predates it. In spite of the paint change, the paste, the slip (including a high frequency of slipslop), and the temper, all fit well within the Cibola series. Overall, Chaco McElmo Black-on-white incorporates traits from Chaco Cibolan, Mesa Verdean, and Tusayan traditions (Franklin and Ford 1982; Windes 1985; Windes and McKenna 1989).

Chaco McElmo Black-on-white stands out for its high frequency of pitchers, as does Chaco Black-on-white (Table 2.14B). Mugs are found only in Mesa Verde and McElmo Black-on-whites, and are rare in this sample. The handle and upper portion of square-shouldered pitchers, however, are very similar to the overall form of mugs (that is, many mugs are pitchers with the hemispherical base cut off and replaced with a flat bottom). In view of its decorative similarities to Mesa Verde Black-on-white (Judd [1959:166-168] calls Chaco San Juan "proto Mesa

Verde") and the formal similarity between mugs and pitchers, a developmental sequence from Chaco McElmo Black-on-white pitchers to Mesa Verde Black-on-white mugs seems likely (see also Bradley 1996; Cattanach 1980:202; Judd 1954:203). Although there are none in this sample, some cylinder jars are Chaco McElmo Black-on-white (Toll 1990).

Although Chaco McElmo Black-on-white overlaps temporally with Chaco and Gallup Black-on-whites, it incorporates very little hachure. Common design elements include checkerboards, parallelograms, dots in the open squares, and interlocking frets. Wide-lined Sosi style is the most frequently recorded decorative technique, but narrow-lined Sosi is absent. Vorsila Bohrer (personal communication 1990) has suggested that dotted checkerboards symbolize corn and may suggest corn beer storage when found on pitchers. This design is found most often in Chaco McElmo Black-on-white, but, though often illustrated, occurs too infrequently in this sample to establish a clear relationship with forms. Red Mesa, Gallup, Escavada, and Puerco Black-on-whites range from 0.3 to 2.5 percent of known rims being ticked ("dotted" in the tables), but 41.6 percent of Chaco McElmo Black-on-white cases show rim ticking, again foreshadowing Mesa Verde Black-on-white.

Trachyte occurs in half of the specimens analyzed for temper. The most frequent category, however, is more-sandstone-than-trachyte, cases in which introduction of trachyte through the use of sherd temper are most likely. Nonetheless, some of the Chaco McElmo Black-on-white in this sample is likely to have come from the Chuska Valley. Tempers are uniformly fine-grained, in keeping with the fine finish associated with this type. Only 10 percent are recorded as lacking sherd temper, and sherd temper is more difficult to see with finely ground aplastics.

Figures: 2A.18 and 2A.19. The Nava Black-on-white olla in Figure 2A.20 is temporally and decoratively similar to McElmo Black-on-white.

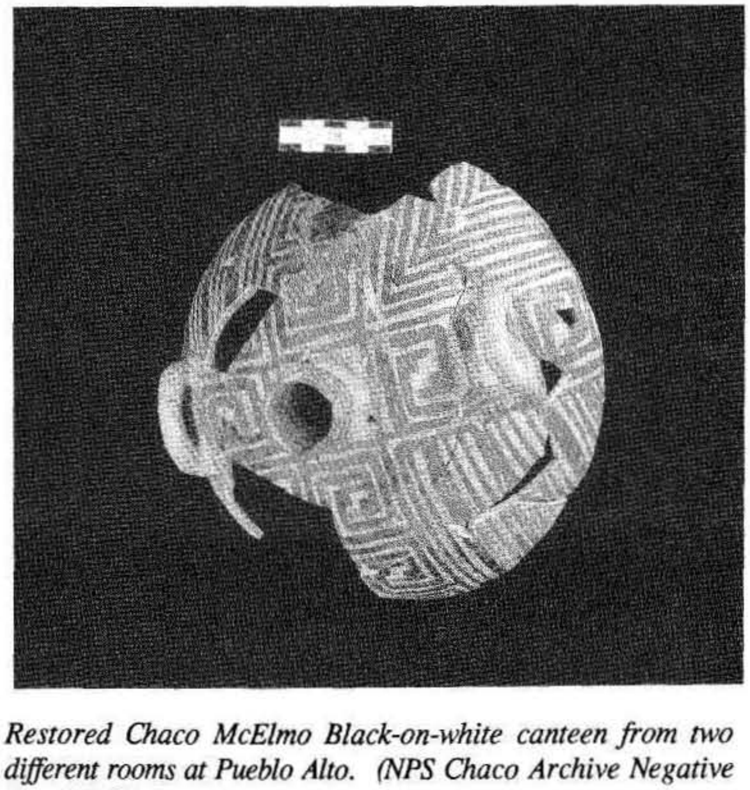


Figure 2A.18. *Restored Chaco McElmo Black-on-white canteen from two different rooms at Pueblo Alto. (NPS Chaco Archive Negative No. 15862).*

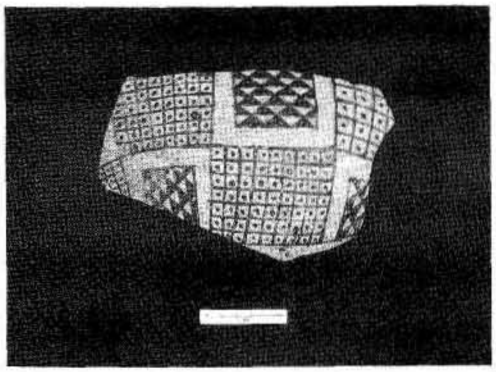


Figure 2A.19. *Chaco McElmo Black-on-white jar sherd from Pueblo Alto. Vorsila Bohrer (personal communication 1991) suggests that this dotted checkerboard motif represented corn. (NPS Chaco Archive Negative No. 23151).*

Figure 2A.20. *Restored Nava/Crumbled House Black-on-white olla from several proveniences at Pueblo Alto. (NPS Chaco Archive Negative No. 23144).*

Table 2A.26. Chaco McElmo Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	-	-	-
Pueblo Alto	77	84.6	1.4
29SJ 423	-	-	-
29SJ 627	1	1.1	0.01
29SJ 628	2	2.2	0.2
29SJ 629	7	7.7	0.4
29SJ 633	2	2.2	0.6
29SJ 721	1	1.1	0.7
29SJ 724	-	-	-
29SJ 1360	1	1.1	0.05
Shabik' eshchee	-	-	-
Total	91	100.0	0.5

A. SURFACE TREATMENT

1. Description

	Motif No.				
Designs	1	2	3	No.	%
Parallel lines	13	2	2	17	13.9
Banded parallel lines	2	-	-	2	1.6
Pendant parallel lines	1	-	-	1	0.8
Ticking	-	1	-	1	0.8
Corner triangles	-	1	-	1	0.8
Scrolls	2	2	1	5	4.1
Dots	-	2	-	2	1.6
Linear dots	1	1	-	2	1.6
Dotted lines	2	-	-	2	1.6
Dotted checkerboard	4	1	-	5	4.1
Checkerboard	1	1	-	2	1.6
Eyed solids	1	-	-	1	0.8
Sawteeth	1	-	-	1	0.8
Barbs	12	5	-	17	13.9
Wide Sosi style	22	4	-	26	21.3
Heavy dotted lines	1	-	-	1	0.8
Heavy curvilinear lines	1	-	-	1	0.8
Solid band design	4	2	-	6	4.9
General solids	9	2	-	11	9.0
Hachure A-3	1	-	1	2	1.6
Interlocked frets	2	1	1	4	3.3
Jar neck motif	1	-	-	1	0.8
Narrow Sosi style	9	1	-	10	8.2
Narrow corrugated 2-5 mm	1	-	-	1	0.8
Totals	91	26	5	122	100.1
No. with 1, 2, 3 treatments	65	21	5	91	-
% with 1, 2, 3 treatments	71.4	23.1	5.5	-	100.0

Type Design Diversity H' = 2.581
s = 24 J = 0.812
Design Distribution Diversity H' = 0.679
s = 3 J = 0.618

Table 2A.26. (continued)

2. Paint

Type	No.	%
Carbon	91	100.0

Rim Decoration	No.	%
Unpainted	38	41.8
Solid line	4	4.4
Dotted	32	35.2
Use-ground	3	3.3
Unknown	14	15.4
Total	91	100.1

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	-	-	-	-	-	-
None	1	1.5	1	3.8	2	2.2
One side						
Streaky	1	1.5	-	-	1	1.1
Moderate	1	1.5	-	-	1	1.1
Completely polished	20	30.8	25	96.2	45	49.5
Both sides						
Streaky	-	-	-	-	-	-
Moderate	-	-	-	-	-	-
Completely polished	35	53.9	-	-	35	38.5
Differential interior/exterior polish	7	10.8	-	-	7	7.7
Totals	65	71.4	26	28.6	91	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	-	-	-	-	-	-
Interior	7	10.8	-	-	7	7.7
Exterior	-	-	13	50.0	13	14.3
Slipslop	44	67.7	12	46.2	56	61.5
Both sides	14	4.5	-	-	14	15.4
Unknown	-	-	1	3.8	1	1.1
Totals	65	71.4	26	28.6	91	100.0

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	62	68.1	46	95-350	196.7	52.749	26.8
Ladle	3	3.3	2	70	-	-	-
Jar	9	9.9	1	230	-	-	-
Pitcher	14	15.4	11	40- 85	66.4	15.181	22.9
Olla	2	2.2	1	70	-	-	-
Canteen	1	1.1	1	30	-	-	-
Total	91	100.0					

Diversity of Forms H' = 1.024
s = 6 J = 0.572

Table 2A.26. (continued)

6. Handles

Type	No.	%
Strap	1	16.7
Strap lug	3	50.0
Effigy	2	33.3
Total	6	100.0

7. No Surface Alteration

Worked sherds = 6 (6.6%).

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Canteen	Pitcher	Olla	Jar	Total
Parallel lines	9	1	1	6	-	-	17
Banded framers	2	-	-	-	-	-	2
Pendant parallel lines	-	-	-	1	-	-	1
Ticking	-	1	-	-	-	-	1
Corner triangles	1	-	-	-	-	-	1
Scrolls	2	-	-	1	1	1	5
Dots	2	-	-	-	-	-	2
Linear dots	1	-	-	1	-	-	2
Dotted lines	1	-	-	-	-	1	2
Dotted checkerboard	3	-	-	1	-	1	5
Checkerboard	2	-	-	-	-	-	2
Eyed solids	-	-	-	1	-	-	1
Sawteeth	-	-	-	-	-	1	1
Barbs	12	-	-	3	-	2	17
Wide Sosi style	17	-	-	3	2	4	26
Heavy dotted lines	1	-	-	-	-	-	1
Heavy curvilinear lines	1	-	-	-	-	-	1
Solid band design	5	1	-	-	-	-	6
General solids	10	-	-	1	-	-	11
Hachure A-3	-	-	-	-	-	1	1
Interlocked frets	3	-	1	-	-	-	4
Jar neck motif	-	-	-	1	1	1	2
Narrow Sosi style	6	1	1	-	-	1	10
Narrow corrugated 2-5 mm	1	-	-	-	-	-	1
Total designs	79	4	3	19	4	13	133
% of designs	64.7	3.3	2.5	3.3	3.3	10.6	-
Total vessels	62	3	1	14	2	9	91
% of vessels	68.1	3.3	1.1	15.4	2.2	9.9	-

Table 2A.26. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=39, 44.3%)		
Fine to medium sandstone > half sherd	20	22.7
Fine to medium sandstone < half sherd	18	20.5
Coarse sandstone < half sherd	1	1.1
Trachyte	2	2.3
Trachyte > sandstone	20	22.7
Sandstone > trachyte	22	25.0
Unidentified igneous with sandstone	1	1.1
Sandstone with unidentified igneous	3	3.4
Sandstone with San Juan igneous without hornblende	1	1.1
Total	88	99.9

Temper Diversity H' = 1.405
s = 7 J = 0.722

2. Texture Attributes

Grain Size	No.	%
Fine	64	72.7
Medium	21	23.9
Coarse	3	3.4
Total	88	100.0

Density	No.	%
1-2%	2	2.4
5%	13	15.5
10%	44	52.3
20%	22	26.2
30%	3	3.6
Total	84	100.0

Sherd Temper	No.	%
None	9	10.2
< half	41	46.6
> half	34	38.6
All	4	4.6
Total	88	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	27	69.2
Medium	11	28.1
Coarse	1	2.6
Very coarse	-	0.1
Total	39	100.0

Texture Index	No.	%
Very fine (0-2)	57	67.9
Fine (2.1-4)	16	19.0
Fine-medium (4.1-7)	8	9.5
Medium (7.1-10)	3	3.6
Medium-coarse (10.1-13)	-	-
Coarse (13.1-16)	-	-
Very coarse (16.1+)	-	-
Total	84	100.0

Table 2A.26. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	38	44.7
Black with white sherd	2	2.4
Gray with black sherd	2	2.4
Gray with black and white	2	2.4
Gray with white sherd	26	30.6
Little Colorado gray	1	1.2
Chuska gray	1	1.2
Tan clay	6	7.0
White clay	7	8.2
Total	85	100.1

Vitrification	No.	%
Absent	19	22.4
Present	59	69.4
Marked	7	8.2
Total	85	100.0

Paste Diversity H' = 1.484
s = 9   J = 0.675

Mesa Verde Black-on-white

References: Breternitz et al. (1974); Cattanach (1980); McKenna and Toll (1991:160-169); Rohn 1971); Smith (1971:283-292); Toll et al. (1980)

Synonyms:

Chuska Carbon: Crumbled House Black-on-white (22.5 percent)

Similar types:

Aztec Black-on-white (mineral paint)
Tusayan: Tusayan Black-on-white

Production span: A.D. 1200 to 1300

Table: 2A.27

Description:

This is a well-known type characterized by fine execution in carbon paint. Designs are in a band layout with multiple lines parallel with the rim, usually with a wider line just below the rim in bowls. Vessel walls are thick, and the rim profile is square. Rim decoration is some variation of ticking in the great majority of cases (Cattanach 1980:184-185; Morris 1939:221; Rohn 1971:172). Exterior designs are common on bowls of this type, especially in examples from later in its production span (see Morris 1939:222; Rohn 1971:168-172). The distinctive mug and kiva jar forms are nearly exclusively associated with this type. The presence of this type is used as a sure indicator of a late deposit since it was not made until A.D. 1200 or shortly before. Because its late date falls after the age of almost all of the proveniences investigated by the Chaco Project, Mesa Verde Black-on-white is scarce in the Chaco Project ceramic assemblage, coming primarily from the limited excavation performed at 29SJ 633. The type does, however, occur at a number of sites in Chaco Canyon and on Chacra Mesa to the east of the Canyon (McKenna 1991:131).

In spite of the misleading implications of its name, it is unlikely that much or any of the small sample of this type found in Chaco Canyon came from Mesa Verde. Over half of the sherds in the detailed sample contain the crushed rock tempers characteristic of this type in the Totah area around modern Farmington, while sherd is the usual temper around Mesa Verde (Shepard 1939; Wilson 1993). Based on the temper, it is possible that up to a quarter of the vessels represented in the sample were made in or near Chaco Canyon. All of the sherds of this type from Pueblo Alto, which are early examples of this decorative style, are trachyte-tempered.

Table 2A.27. Mesa Verde Black-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	2	4.8	0.4
29SJ 299 PI	-	-	-
Pueblo Alto	4	9.5	0.1
29SJ 423	-	-	-
29SJ 627	2	4.8	0.03
29SJ 628	-	-	-
29SJ 629	2	4.8	0.1
29SJ 633	32	76.2	10.1
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	-	-	-
Shabik'eshchee	-	-	-
Total	42	100.1	0.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Parallel lines	3	1	-	4	5.1
Cribbed parallel lines	2	-	-	2	2.6
Banded framers	12	2	-	14	17.9
Scrolls	2	-	1	3	3.8
Framing dots	-	1	-	1	1.3
Dotted lines	2	1	-	3	3.8
Parallelograms	-	1	-	1	1.3
Checkerboard	2	-	-	2	2.6
Barbs	1	-	-	1	1.3
Wide Sosi style	1	-	-	1	1.3
Narrow Sosi style	-	2	-	2	2.6
Heavy dotted lines	-	1	-	1	1.3
Heavy curvilinear lines	2	1	-	3	3.8
Solid band design	2	4	1	7	9.0
General solids	2	5	-	7	9.0
Bold bisecting lines	-	1	-	1	1.3
Hachure B-1	1	-	-	1	1.3
Hachure B-3	1	-	-	1	1.3
Counterchange	-	2	-	2	2.6
Interlocked frets	1	1	1	3	3.8
Exterior bowl motif	5	3	7	15	19.2
Jar neck motif	-	1	-	1	1.3
Others, hachure	2	-	-	2	2.6
Totals	41	27	10	78	100.1
No. with 1, 2, 3 treatments	14	17	10	41	-
% with 1, 2, 3 treatments	34.1	41.5	24.4	-	100.0

Type Design Diversity H' = 2.684
s = 23 J = 0.856
Design Distribution Diversity H' = 0.969
s = 3 J = 0.882

Table 2A.27. (continued)

2. Paint

Type	No.	%
Carbon	42	100.0

Rim Decoration	No.	%
Unpainted	2	4.8
Solid line	1	2.4
Dotted	30	71.4
Use-ground	1	2.4
Unknown	8	19.0
Total	42	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	2	5.3	-	-	2	4.8
None	-	-	-	-	-	-
One side	-	-	-	-	-	-
Streaky	-	-	-	-	-	-
Moderate	-	-	-	-	-	-
Completely polished	-	-	3	75.0	3	7.1
Both sides						
Streaky	-	-	-	-	-	-
Moderate	-	-	-	-	-	-
Completely polished	36	94.7	1	25.0	37	88.1
Differential interior/exterior polish	-	-	-	-	-	-
Totals	38	90.5	4	9.5	42	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	-	-	-	-	-	-
Interior	-	-	-	-	-	-
Exterior	-	-	2	50.0	2	4.8
Slipslop	1	2.6	1	25.0	2	4.8
Both sides	37	97.4	1	25.0	38	90.5
Unknown	-	-	-	-	-	-
Totals	38	90.5	4	9.5	42	100.1

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	34	81.0	25	110-315	213.0	57.155	26.8
Ladle	4	9.5	3	70- 95	81.7	12.583	15.4
Canteen	1	2.4	1	200	-	-	-
Olla	2	4.8	2	90-110	100.0	14.192	14.1
Mug	1	2.4	1	80	-	-	-
Totals	42	100.1					

Diversity of Forms H' = 0.718
s = 5 J = 0.446

Table 2A.27. (continued)

6. Handles

Type	No.	%
Strap	1	20.0
Tubular	3	60.0
Strap lug	1	20.0
Total	5	100.0

Handles:items = 1:8
(Excluding ladles from forms and handles)

7. Surface Alteration

No surface alteration
Worked sherds = 14 (33.3%).

8. Designs by Vessel Forms

Designs	Bowl	Ladle	Canteen	Mug	Olla	Total
Parallel lines	3	-	-	1	-	4
Cribbed parallel lines	1	-	-	-	1	2
Banded framers	14	-	-	-	-	14
Scrolls	1	2	-	-	-	3
Framing dots	-	1	-	-	-	1
Dotted lines	1	1	1	-	-	3
Parallelograms	-	-	-	-	1	1
Checkerboard	2	-	-	-	-	2
Barbs	1	-	-	-	-	1
Wide Sosi style	1	-	-	-	-	1
Narrow Sosi style	1	1	-	-	-	2
Heavy dotted lines	-	1	-	-	-	1
Heavy curvilinear line	2	-	1	-	-	3
Solid band design	7	-	-	-	-	7
General solids	7	-	-	-	-	7
Bold bisecting lines	1	-	-	-	-	1
Hachure B-1	1	-	-	-	-	1
Hachure B-3	-	-	-	-	1	1
Counterchange	2	-	-	-	-	2
Interlocked frets	2	-	-	1	-	3
Bowl exterior motif	12	3	-	-	-	15
Jar neck motif	-	-	-	-	1	1
Others, hachure	2	-	-	-	-	2
Total of design	61	9	2	2	4	78
% of design	78.2	11.5	2.6	2.6	5.1	-
Total of vessels	34	4	1	1	2	42
% of vessels	81.0	9.5	2.4	2.4	4.8	-

Table 2A.27. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Fine to medium sandstone < sherd	8	20.0
Magnetitic sandstone	2	5.0
Trachyte	3	7.5
Trachyte > sandstone	6	15.0
San Juan igneous with hornblende	2	5.0
Sandstone with San Juan igneous with hornblende	4	10.0
San Juan igneous without hornblende	5	12.5
San Juan igneous with sandstone	4	10.0
Unidentified igneous with sandstone	6	15.0
Total	40	100.0

Temper Diversity H' = 2.105
s = 9 J = 0.958

2. Texture Attributes

Grain Size	No.	%
Fine	11	27.5
Medium	22	55.0
Coarse	7	17.5
Total	40	100.0

Density	No.	%
10%	15	40.5
20%	18	48.7
30%	4	10.8
Total	37	100.0

Sherd Temper	No.	%
None	15	37.5
< half	10	25.0
> half	13	32.5
All	2	5.0
Total	40	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	8	100.0
Medium	-	-
Coarse	-	-
Very coarse	-	-
Total	8	100.0

Texture Index	No.	%
Very fine (0-2)	7	18.9
Fine (2.1-4)	10	72.0
Fine-medium (4.1-7)	7	18.9
Medium (7.1-10)	2	5.4
Medium-coarse (10-1-13)	3	8.1
Coarse (13.1-16)	2	5.4
Very coarse (16.1+)	6	16.2
Total	37	99.9

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	21	55.3
Black with white sherd	1	2.6
Gray with black sherd	1	2.6
Gray with black and white	1	2.6
Gray with white sherd	4	10.5
Chuska gray homogeneous	3	7.9
Tan to brown clay	5	13.2
White clay	2	5.3
Total	38	100.0

Vitrification	No.	%
Absent	4	10.5
Present	27	71.1
Marked	7	18.4
Total	38	100.0

Paste Diversity H' = 1.474
s = 8 J = 0.709

Tusayan Carbon-on-white

References: Colton and Hargrave (1937); Goetze and Mills (1993:44-49).

Included Types:

Black Mesa Black-on-white, Sosi Black-on-white, Dogoszhi Black-on-white
Flagstaff

Similar types:

Chuska carbon: Chuska, Toadlena, Nava Black-on-whites

Production span: A.D. 1050 to 1200

Table: 2A.28

Description:

This group contains all post Pueblo I specimens recognized as being Tusayan. Key criteria in this recognition include carbon paint, slip that is smoother and denser white than Cibola slips, tendency to light-colored paste, and use of abundant, medium to coarse, homogeneous, clear sand temper. Unlike members of the Cibola series, most rims in this type are unpainted. Slipslop slipping is also absent. Tusayan whitewares found in Chaco Canyon are nearly all bowls.

***Table 2A.28.** Tusayan Carbon-on-white definition (Sosi-Black Mesa Black-on-white).*

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	-	-	-
29SJ 299 PI	-	-	-
Pueblo Alto	44	49.4	0.8
29SJ 423	-	-	-
29SJ 627	45	50.6	0.6
29SJ 628	-	-	-
29SJ 629	-	-	-
29SJ 633	-	-	-
29SJ 721	-	-	-
29SJ 724	-	-	-
29SJ 1360	-	-	-
Shabik'eshchee	-	-	-
Total	89	100.0	0.4

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Stars, suns	-	1	1	2	1.7
Parallel lines	1	-	-	1	0.8
Pendant parallel lines	3	1	-	4	3.3
Scrolls	1	2	-	3	2.5
Parallelograms	1	-	-	1	0.8
Checkerboard	1	-	-	1	0.8
Eyed solids	-	1	-	1	0.8
Sawteeth	1	1	-	2	1.7
Barbs	1	3	-	4	3.3
Elongated scalloped triangles	-	1	-	1	0.8
Wide Sosi style	38	3	-	41	34.2
Heavy dotted lines	2	2	-	4	3.3
Heavy curvilinear lines	14	-	1	15	12.5
Solid band design	6	2	-	8	6.7
Isolated triangles	3	-	-	3	2.5
General solids	11	5	-	16	13.3
Hachure B/C	1	-	-	1	0.8
Interlocked frets	-	1	1	2	1.7
Anthro/zoomorphs	-	1	-	1	0.8
White exterior design	2	6	-	8	6.7
Interlocked ticking	1	-	-	1	0.8
Totals	87	30	3	120	99.8
No. with 1, 2, 3 treatments	57	27	3	87	-
% with 1, 2, 3 treatments	65.5	31.0	3.5	-	100.0

Type Design Diversity $H' = 2.305$
$s = 21$ $J = 0.757$
Design Distribution Diversity $H' = 0.672$
$s = 3$ $J = 0.612$

Table 2A.28. (continued)

2. Paint

Type	No.	%
Mineral: black	2	2.3
Mineral-carbon	1	1.1
Carbon	86	96.6
Total	89	100.0

Rim Decoration	No.	%
Unpainted	75	84.3
Solid line	2	2.2
Use-ground	2	2.2
Unknown	10	11.2
Total	89	99.9

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	5	5.7	-	-	5	5.6
None	-	-	-	-	-	-
One side						
Streaky	2	2.3	-	-	2	2.2
Moderate	1	1.2	1	50.0	2	2.2
Completely polished	50	57.7	1	50.0	51	57.3
Both sides						
Streaky	-	-	-	-	-	-
Moderate	1	1.2	-	-	1	1.1
Completely polished	11	12.6	-	-	11	12.4
Differential interior/exterior polish	17	19.5	-	-	17	19.1
Totals	87	97.8	2	2.2	89	99.9

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	4	4.6	-	-	4	4.5
Interior	60	69.0	-	-	60	67.4
Exterior	-	-	2	100.0	2	2.2
Slipslop	-	-	-	-	-	-
Both sides	21	24.1	-	-	21	23.6
Unknown	2	2.3	-	-	2	2.2
Totals	87	97.8	2	2.2	89	99.9

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	85	95.5	61	85-305	203.3	52.009	25.6
Ladle	2	2.3	2	100-180	140.0	56.569	40.4
Canteen	1	1.1	1	40	-	-	-
Seed jar	1	1.1	1	55	-	-	-
Total	89	100.0					

Diversity of Forms $H' = 0.230$
$s = 4$ $J = 0.166$

6. Handles

Type	No.	%
None	-	-

Table 2A.28. (continued)

7. Surface Alteration

Type	No.	%
None	86	96.6
Blackened	2	2.2
Fugitive red	1	1.1
Total	89	99.9

Worked sherds = 12 (13.5%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Tusayan sandstone	67	90.5
Magnetitic sandstone	2	2.7
Trachyte	2	2.7
Sandstone > trachyte	1	1.4
Sandstone with unidentified igneous	2	2.7
Total	74	100.0

2. Texture Attributes

Grain Size	No.	%
Very fine	12	16.2
Medium	55	74.3
Very coarse	7	9.5
Totals	74	100.0

Density	No.	%
5%	1	1.4
10%	16	22.5
20%	39	54.9
30%	14	19.7
>40%	1	1.4
Totals	71	99.9

Sherd Temper	No.	%
None	60	81.1
< half	10	13.5
> half	4	5.4
Totals	74	100.0

Tusayan Sandstone Grain Size	No.	%
Very fine	10	14.9
Medium	50	74.6
Very coarse	7	10.4
Total	67	99.9

Texture Index	No.	%
Very fine	3	4.2
Fine	9	12.7
Fine-medium	6	8.5
Medium	13	18.3
Medium-coarse	25	35.2
Coarse	12	16.9
Very coarse	3	4.2
Total	71	100.0

Table 2A.28. (continued)

3. Clay Attributes

Clay-temper types	No.	%	Vitrification	No.	%
No type assigned	53	73.6	Absent	18	24.3
Black with white sherd	2	2.8	High-fired	23	31.1
Gray with black and white sherd	1	1.4	Marked	33	44.6
Gray with white sherd	1	1.4	Total	74	100.0
"Little Colorado" gray	1	1.4			
Chuska gray	1	1.4			
Tan to brown clay	2	2.8			
Black clay	6	8.3			
White clay	5	6.9			
Total	72	100.0			

Chuska Black-on-white

References: Goetze and Mills (1993); Peckham and Wilson (1964); Windes (1977)

Synonyms:

Burnham Black-on-white

Similar types:

Cibola: Gallup Black-on-white
Chuska mineral: Brimhall Black-on-white
Mesa Verde: Wetherill Black-on-white, Mancos Black-on-white
Tusayan: Dogoszhi Black-on-white

Production span: A.D. 1000 to 1125

Table: 2A.29

Description:

Chuska Black-on-white is essentially carbon-painted, trachyte-tempered Gallup Black-on-white. Hachure is therefore the third criterion for inclusion in this type, and constitutes the main design form. As classified here, Hachure A is more common in Chuska Black-on-white than in Gallup Black-on-white, although at least some of the items with Hachure A should have been placed in Chuska Carbon with Red Mesa design (or Burnham Black-on-white). Use of other hachure styles is also different: Hachure B-4 is the most common Gallup Black-on-white on type but ranks fourth in Chuska Black-on-white, while Hachure B-1 is most common in Chuska Black-on-white (second most in Gallup Black-on-white). Hachure B-6 is considerably more common in Chuska than in Gallup Black-on-white (see Figure 2.3). The Chuska Black-on-white form assemblage is very close to the overall form assemblage (Table 2.14B), suggesting it is less like an import than a local ware in Chaco Canyon. It does, however, contain lower percentages of closed forms and more bowls and ladles than Gallup Black-on-white.

Table A.29. *Chuska Black-on-white definition.*

Site	Site Occurrence No.	% of Type	% of Site
29SJ 299 PI	2	1.8	0.8
Pueblo Alto	81	71.1	1.5
29SJ 627	24	21.1	0.3
29SJ 629	3	2.6	0.2
29SJ 633	1	0.9	0.3
29SJ 721	1	0.9	0.7
29SJ 1360	2	1.8	0.1
Total	114	100.0	0.6

A. SURFACE TREATMENT

Designs	Motif No. 1	2	3	No.	%
Parallel lines pendant from rim	1	-	-	1	0.8
Hatched band design	2	-	-	2	1.5
Undifferentiated solid	1	2	-	3	2.2
Hachure A-1	2	1	-	3	2.2
Hachure A-2	1	-	-	1	0.8
Hachure A-3	5	-	-	5	3.7
Hachure B-1	36	2	-	38	28.4
Hachure B-2	2	-	-	2	1.5
Hachure B-3	14	-	-	14	10.5
Hachure B-4	7	-	-	7	5.2
Hachure B-6	15	-	-	15	11.2
Hachure B-C	3	-	-	3	2.2
Hachure C	1	-	-	1	0.8
Crosshatched	9	-	-	9	6.7
Hatched checkerboard	1	-	-	1	0.8
Heavy Gallup squiggle	3	-	-	3	2.2
Hatched pendant triangles	1	-	-	1	0.8
Other hatchure	10	-	1	11	8.2
Solid corner triangles	-	7	1	8	6.0
Sawteeth	-	2	-	2	1.5
Solid ticked triangles	-	1	-	1	0.8
Painted exterior design	-	1	1	2	1.5
Jar neck design	-	-	1	1	0.8
Totals	114	16	4	134	100.3
No. with 1, 2, 3 treatments	98	12	4	114	-
% with 1, 2, 3 treatments	86.6	10.5	3.5		100.6

2. Paint

Type	No.	%
Carbon	114	100.0
Total	114	100.0

Rim Decoration	No.	%
Unpainted	18	15.8
Solid	42	36.8
Dots or dashes	4	3.5
Eroded paint	2	1.8
Worn	9	7.9
Unknown	39	34.2
Total	114	100.0

Table A.29. (continued)

3. Polish

Type	Open		Closed		Total	
	No.	%	No.	%	No.	%
Unknown	1	1.1	-	-	1	0.9
One side						
Moderate	1	1.1	1	4.0	2	1.8
Completely polished	20	22.5	23	92.0	43	37.7
Both sides						
Streaky	1	1.1	1	4.0	2	1.8
Moderate	1	1.1	-	-	1	0.9
Completely polished	50	56.2	-	-	50	43.9
Differential interior/exterior polish	15	16.9	-	-	15	13.2
Totals	89	100.0	25	100.0	114	100.0

4. Slip

Type	Open		Closed		Total	
	No.	%	No.	%	No.	%
Interior	4	4.5	-	-	4	3.5
Exterior	1	1.1	19	76.0	20	17.5
Slipslop	-	-	4	16.0	4	3.5
Both sides	81	91.0	2	8.0	83	72.8
Unknown	3	3.4	-	-	3	2.6
Totals	89	100.0	25	100.0	114	100.0

5. Forms and Metrics

Form	No.	%	Orifice Diameter (mm)				
			No.	Range	x̄	s.d.	cv %
Bowl	76	66.7	51	80-350	223.6	62.06	27.8
Ladle	13	11.4	8	80-230	126.9	54.83	43.2
Pitcher	4	3.5	3	70-75	71.7	2.89	4.0
Tecomate	1	0.9	-	-	-	-	-
Olla	3	2.6	2	65-80	72.5	-	-
Whiteware Jar	17	14.9	2	110-135	122.5	-	-
Total	114	100.0					

6. Handles

Type	No.	%
Solid coil	1	10.0
Strap	2	20.0
Tubular	1	10.0
Trough-gourd	5	50.0
Strap lug	1	10.0
Total	10	100.0

Handles:items 1:14
(Excluding ladles from forms and handles)

Table A.29. (continued)

7. Surface Alteration

	No.	%
Sooted	1	0.9
Absent	108	94.7
Blackened	3	2.6
Fugitive red	1	0.9
Mineral encrustation	1	0.9
Total	114	100.0

Worked sherds = 8 (7.0%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated igneous	1	1.1
Trachyte	67	73.6
Trachyte > sandstone	22	24.2
Sandstone with trachyte	1	1.1
Total	114	100.0

2. Texture Attributes

Grain Size	No.	%
Fine	31	34.1
Medium	41	45.1
Coarse	1	1.1
Very coarse	18	19.8
Total	91	100.0

Density	No.	%
1-2%	1	1.2
5%	3	3.7
10%	20	24.7
20%	34	42.0
30%	20	24.7
>40%	3	3.7
Total	81	100.0

Sherd Temper	No.	%
None	74	81.3
< half	13	14.3
> half	4	4.4
Total	91	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	5	21.7
Medium	16	69.6
Coarse	1	4.3
Very coarse	1	4.3
Total	23	99.9

Texture Index	No.	%
Very fine	9	11.1
Fine	9	11.1
Fine-medium	19	23.5
Medium	10	12.3
Medium-coarse	16	19.8
Coarse	14	17.3
Very coarse	4	4.9
Total	81	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type	20	24.4
Black and white sherd	1	1.2
Chuska gray paste	51	62.2
Gray paste, white sherd	2	2.4
Tan paste	5	6.1
Black paste	1	1.2
White paste	2	2.4
Total	82	99.9

Vitrification	No.	%
Absent	16	18.2
High-fired	52	59.1
Clearly vitrified	20	22.7
Total	88	100.0

Chuska Carbon-on-white

References: Peckham and Wilson (1964); Windes (1977)

Included Types:

Nava, Toadlena, Newcomb Black-on-white

Similar types:

Cibola: Pueblo II-III Carbon-on-white
Tusayan: Black Mesa, Sosi, and Dogoszhi Black-on-whites

Production span: A.D. 900 to 1200

Table: 2A.30

Description:

This group includes sherds that were recognizably Chuskan during the classification phase (before the temper analysis), based on slip, carbon paint, paste color, and visible trachyte, but which could not be placed in more specific groups (Chuska Black-on-white, Chuska Carbon-on-white with Red Mesa Design), either because of insufficient design field or absence of appropriate category. Its catchall nature may be seen in the fact that the two most common design elements are the generic "general solid" and "solid band design." Clearly, there is overlap with several other type groups: Pueblo II-III Carbon-on-white, Chuska Black-on-white, and Chuska Carbon-on-white with Red Mesa Design. The presence of wide and narrow Sosi styles, as well as Hachure A and pendant parallel lines, indicates that the group covers several typological time groups. As in Chuska Carbon-on-white with Red Mesa Design, there is a high frequency of ladles in this group (17 percent).

Table 2A.30. Chuska Carbon-on-white definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
Pueblo Alto	138	56.6	2.6
29SJ 423	1	0.4	0.2
29SJ 627	82	33.6	1.1
29SJ 629	5	2.0	0.3
29SJ 633	2	0.8	0.6
29SJ 721	1	0.4	0.7
29SJ 1360	15	6.1	0.7
Total	244	100.0	1.2

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	-	1	-	1	0.4
Unnested isolates	1	-	-	1	0.4
Non-overlapping steps	1	-	1	2	0.7
Parallel lines	15	1	-	16	5.7
Banded framers	3	1	-	4	1.4
Pendant parallel lines	11	7	-	18	6.4
Framers with unticked solids	3	-	-	3	1.1
Ticking	1	-	1	2	0.7
Corner triangles	-	2	-	2	0.7
Scrolls	8	7	2	17	6.0
Dots	1	-	-	1	0.4
Dotted lines	3	-	-	3	1.1
Checkerboard	4	-	-	4	1.4
Sawteeth	11	6	1	18	6.4
Barbs	9	4	-	13	4.6
Wide Sosi style	23	3	-	26	9.2
Narrow Sosi style	7	1	-	8	2.8
Heavy dotted lines	1	-	-	1	0.4
Heavy curvilinear lines	8	2	-	10	3.5
Narrow curvilinear lines	2	-	-	2	0.7
Solid band design	29	5	2	36	12.7
Isolated triangles	2	-	1	3	1.1
General solids	40	5	2	47	16.6
Hachure A-1	12	-	-	12	4.2
Hachure B-1	3	-	-	3	1.1
Hachure B-3	1	-	-	1	0.4
Hachure B-7	-	1	-	1	0.4
Other hachure	5	1	-	6	2.1
Squiggle lines	2	-	-	2	0.7
Interlocked frets	1	2	-	3	1.1
Anthro/zoomorphs	4	1	-	5	1.8
Solid ticked triangles	1	1	-	2	0.7
Exterior bowl motif	3	-	-	3	1.1
Jar neck motif	6	1	-	7	2.5

Table 2A.30. (continued)

Designs	Motif No. 1	2	3	No.	%
Totals	221	52	10	283	100.5
No. with 1, 2, 3 treatments	169	42	10	283	-
% with 1, 2, 3 treatments	59.7	14.8	3.5	-	78.0
26 cases with no design recorded					

2. Paint

Type	No.	%
Unpainted	2	0.8
Mineral Brown	3	1.2
Carbon	238	97.5
Unknown	1	0.4
Total	244	100.0

Rim Decoration	No.	%
Unpainted	76	31.1
Solid	55	22.5
Dotted	17	7.0
Eroded paint	7	2.9
Worn: paint gone	37	15.2
Unknown	52	21.3
Total	244	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	6	3.3	8	13.6	14	5.8
None	3	1.6	1	1.7	4	1.7
Streaky	1	0.5	3	5.1	4	1.7
One side						
Moderate	2	1.1	6	10.2	8	3.3
Completely polished	33	18.1	39	66.1	72	29.9
Both sides						
Moderate	2	1.1	-	-	2	0.8
Completely polished	98	53.8	2	3.4	100	41.5
Differential interior/exterior polish	37	20.3	-	-	37	15.4
Totals	182	100.0	59	100.0	241	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	1	0.5	1	1.7	2	0.8
Interior	15	8.2	-	-	15	6.2
Exterior	2	1.1	33	55.9	35	14.5
Slipslop	6	3.3	23	39.0	29	12.0
Both sides	152	83.5	2	3.4	154	63.9
Unknown	6	3.3	-	-	6	2.5
Totals	182	100.0	59	100.0	241	100.0

Table 2A.30. (continued)

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	140	57.4	93	60-350	184.1	66.76	36.3
Canteen	1	0.4					
Duck pot	2	0.8					
Effigy	1	0.4					
Ladle	42	17.2	30	40-240	102.2	39.28	38.4
Mug	1	0.4					
Pitcher	13	5.3	8	50-95	74.4	15.91	21.4
Tecomate	1	0.4					
Olla	17	7.0	14	30-110	73.2	18.15	24.8
Gourd jar	1	0.4					
Whiteware jar	22	9.0	7	70-110	86.4	17.01	19.7
Unknown	3	1.2					
Total	244	100.0					

6. Handles

	No.	%
Solid coil	3	8.6
Multiple solid coil	4	11.4
Strap	10	28.6
Tubular	2	5.7
Perforated tubular	1	2.9
Trough-gourd	10	28.6
Strap lug	4	11.4
Cupule lug	1	2.9
Total	35	100.1

Handles:items 1:9
(Excluding ladles from forms and handles).

7. Surface Alteration

	No.	%
Sooted	2	0.8
Absent	242	99.2
Totals	244	100.0

Worked sherds=16 (6.6%).

Table 2A.30. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=9, 4.1%)		
Fine to medium sandstone > sherd	7	3.2
Fine to medium sandstone < sherd	1	0.5
Coarse sandstone > sherd	1	0.5
Trachyte	151	68.3
Trachyte > sandstone	49	22.2
Sandstone > trachyte	11	5.0
Unidentified igneous with sandstone	1	0.5
Total	221	100.0

2. Texture Attributes

Grain Size	No.	%
Fine	74	33.5
Medium	106	48.0
Coarse	35	15.8
Very coarse	6	2.7
Total	244	100.0

Density	No.	%
1-2%	1	0.5
5%	6	3.0
10%	69	34.2
20%	79	39.1
30%	40	19.8
>40%	7	3.5
Total	244	100.1

Sherd Temper	No.	%
None	159	71.9
< half	43	19.5
> half	19	8.6
Total	244	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	27	38.6
Medium	34	48.6
Coarse	9	12.9
Very Coarse	-	-
Total	70	100.1

Texture Index	No.	%
Very fine	27	13.4
Fine	31	15.3
Fine-medium	38	18.8
Medium	40	19.9
Medium-coarse	26	12.9
Coarse	23	11.4
Very coarse	17	8.4
Total	202	100.0

3. Clay Attributes

Clay-temper types	No.	%
No type	66	32.5
Black clay with white sherd	5	2.5
Gray with black sherd	1	0.5
Gray with black and white sherd	1	0.5
Chuska gray paste	110	54.2
Gray paste, white sherd	7	3.4
Tan to brown clay	9	4.4
Black clay	2	1.0
White clay	2	1.0
Total	203	100.0

Vitrification	No.	%
Absent	47	21.4
High-fired	98	44.5
Marked	75	34.1
Total	220	100.0

Chuska Carbon-on-white with Red Mesa Design

References: Peckham and Wilson (1964); Windes (1977)

Synonyms:

Tunicha, Newcomb, Burnham Black-on-whites

Similar types:

Cibola: Kiatuthlanna, Red Mesa Black-on-whites
Chuska mineral: Naschitti, Brimhall Black-on-white
Mesa Verde: Cortez Black-on-white
Tusayan: Wepo and Black Mesa Black-on-whites

Production span: A.D. 875 to 1000

Table: 2A.31

Description:

This type uses the Red Mesa design set executed in carbon paint on trachyte-tempered pottery; Windes thinks this type generally falls more toward the early part of Red Mesa Black-on-white's span. Parallel lines, ticked triangles, scrolls, and especially Hachure A are all common decorations. Motif occurrence is fairly similar to Red Mesa Black-on-white, although Hachure A-1 and pendant parallel lines are more common in the Chuska group and ticked triangles are more common in Red Mesa Black-on-white. Slipping on both sides is more common in this Chuska group than in Red Mesa Black-on-white, and slipslop is uncommon. Ladles and jars are relatively abundant forms in this type group compared to most other decorated types, including the contemporaneous mineral-painted types (Early Red Mesa, Red Mesa Black-on-whites). A good example of this group from 29SJ 627 is illustrated in Toll and McKenna (1992:216).

Table 2A.31. Chuska Carbon-on-white with Red Mesa Design definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	3	2.3	0.6
29SJ 299 PI	1	0.8	0.4
Pueblo Alto	29	22.5	0.5
29SJ 423	-	-	-
29SJ 627	58	45.0	0.8
29SJ 628	1	0.8	0.1
29SJ 629	8	6.2	0.5
29SJ 633	-	-	-
29SJ 721	-	-	-
29SJ 724	1	0.8	0.2
29SJ 1360	28	21.7	1.3
Shabik'eshchee	-	-	-
Total	129	100.1	0.6

A. SURFACE TREATMENT

1. Decoration

	Motif No.				
Designs	1	2	3	No.	%
Hooks, flags	-	1	-	1	0.5
Non-overlapping steps, zigzag	-	1	-	1	0.5
Parallel lines	9	4	1	14	7.3
Cribbed parallel lines	4	-	-	4	2.1
Pendant parallel lines	10	5	1	16	8.4
Framers with unticked solids	10	-	-	10	5.2
Ticking	-	1	-	1	0.5
Corner triangles	1	5	-	6	3.1
Scrolls	7	7	2	16	8.4
Framing dots	-	1	-	1	0.5
Dotted lines	3	2	1	6	3.1
Checkerboard	1	-	-	1	0.5
Sawteeth	2	3	-	5	2.6
Barbs	-	2	-	2	1.1
Narrow Sosi style	-	1	-	1	0.5
Solid band design	31	4	1	36	18.9
General solids	3	6	-	9	4.7
Hachure A-1	37	2	1	40	21.1
Hachure B/C	1	-	-	1	0.5
Heavy Gallup squiggle	1	-	-	1	0.5
Squiggle lines	1	2	-	3	1.6
Interlocked frets	2	-	-	2	1.1
Solid ticked triangles	4	6	1	11	5.8
Interlocked ticking	1	-	-	1	0.5
Narrow neckbanding	-	1	-	1	0.5
Totals	128	54	8	190	
No. with 1, 2, 3 treatments	74	46	8	128	-
% with 1, 2 3 treatments	57.8	35.9	6.3	-	100.0

Table A.31. (continued)

2. Paint

Type	No.	%
Mineral black	2	1.6
Carbon	127	98.4
Total	129	100.0

Rim Decoration	No.	%
Unpainted	19	14.7
Solid line	44	34.1
Dotted	2	1.6
Eroded solid line	5	3.9
Use-ground	18	14.0
Unknown	41	31.8
Total	129	100.0

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	4	4.6	1	2.5	5	3.9
None	1	1.1	1	2.5	2	1.6
One side						
Streaky	1	1.1	-	-	1	0.8
Moderate	-	-	1	2.5	1	0.8
Completely polished	15	17.2	37	92.5	52	40.9
Both sides						
Moderate	2	2.3	-	-	2	1.6
Completely polished	52	59.8	-	-	52	40.9
Differential interior/exterior polish	12	13.8	-	-	12	9.4
Totals	87	100.0	40	100.0	127	100.0

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Interior	6	6.9	-	-	6	4.7
Exterior	-	-	36	90.0	36	28.3
Slipslop	-	-	3	7.5	3	2.4
Both sides	78	89.7	-	-	78	61.4
Unknown	3	3.4	1	2.5	4	3.1
Totals	87	100.0	40	100.0	127	100.0

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	x̄	s.d.	cv %
Bowl	66	51.2	46	60-330	181.4	51.75	28.5
Canteen	1	0.8	-	-	-	-	-
Ladle	21	16.3	11	70-190	119.1	38.00	31.9
Whiteware jar	23	17.8	4	55-95	72.5	16.58	22.9
Olla	1	0.8	1	90	-	-	-
Pitcher	14	10.9	11	60-115	76.8	17.79	23.2
Miniature vessel	1	0.8					
Unknown	2	1.6					
Total	129	100.0					

Table A.31. (continued)

6. Handles

Type	No.	%
Solid coil	1	6.7
Multiple solid coil	1	6.7
Strap	3	20.0
Trough-gourd	9	60.0
Indented	1	6.7
Total	15	100.1

Handles:items = 1:18
(Excluding ladles and unknowns from forms and handles).

7. Surface Alteration

Type	No.	%
Absent	124	96.9
Blackening	1	0.8
Fugitive red	1	0.8
Mineral encrustation	2	1.6
Total	128	100.1

Worked sherds=24 (18.6%).

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=3, 2.6%)		
Fine to medium sandstone > sherd	2	1.7
Fine to medium sandstone < sherd	1	0.9
Trachyte	87	74.4
Trachyte > sandstone	26	22.2
Sandstone > trachyte	1	0.9
Total	117	100.1

2. Texture Attributes

Grain Size	No.	%
Fine	42	35.9
Medium	63	53.8
Very coarse	12	10.3
Total	117	100.0

Density	No.	%
5%	4	3.7
10%	19	17.8
20%	52	48.6
30%	27	25.2
>40%	5	4.7
Total	107	100.0

Sherd Temper	No.	%
None	86	73.5
< half	26	22.2
> half	5	4.3
Total	117	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	8	26.7
Medium	19	63.3
Coarse	3	10.0
Very coarse	-	-
Total	30	100.0

Texture Index	No.	%
Very fine	12	11.2
Fine	14	13.1
Fine-medium	23	21.5
Medium	15	14.0
Medium-coarse	31	29.0
Coarse	9	8.4
Very coarse	3	2.8
Total	107	100.0

Table A.31. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type	31	28.7
Black and white sherd	2	1.9
Gray with black sherd	1	0.9
Gray with black and white sherd	1	0.9
Chuska gray paste	68	63.0
Gray paste, white sherd	3	2.8
Tan to brown clay	1	0.9
White clay	1	0.9
Total	108	100.0

Vitrification	No.	%
Absent	22	19.6
High-fired	44	39.3
Marked	46	41.1
Total	112	100.0

REDWARES

Black-on-red

References: Abel (1955); Breternitz et al. (1974); Carlson (1970); Colton (1956); Goetze and Mills (1993:69-78); Peckham and Wilson (1964:100-101); Toll and McKenna (1987:154-158)

Included types:

Chuska: Sanostee Red-on-orange (6.9 percent)
San Juan: Abajo Red-on-orange, Bluff Black-on-red, Deadmans Black-on-red (37.8 percent)
White Mountain: Puerco, Wingate Black-on-red
Tsegi Orangeware: Tusayan Black-on-red, Tsegi Orange

Production span: A.D. 700 to 1200

Table: 2A.32

Description:

This "type" is an unfortunate artifact of the rough sort strategy, since at least series, if not types, could have been easily recorded. To an extent, the series can be reconstructed using temper data, and the data presented here are divided by temper. The most unfortunate loss is the ability to confidently discriminate between White Mountain Redwares and Tusayan Redwares. Paste observations made at the sites where sherds from these series were most abundant—Pueblo Alto and 29SJ 627—give an indication of some cases which are likely to be White Mountain types in the black or gray pastes with white sherd, but there are surely White Mountain Redwares which are not indicated by these paste codes. The San Juan and Sanostee identifications in Table 2A.32 are reliable; the Woodruff group is based on occurrence of plain red pottery in early contexts, primarily at 29SJ 423; the "Sandstone" and "General" categories are more muddled, containing White Mountain and Tsegi sherds, as well as sherds lacking clear temper identification. This sandstone group is not to be confused with the no longer used "Sandstone Black-on-red," a type name used by Hawley (Kluckhohn and Reiter 1939) to cover Sanostee Black-on-red.

Attributes not monitored by the analysis, such as slip color, are important in separating series—while both Tsegi and San Juan pottery tend toward orange surfaces, White Mountain pottery is a deeper red with more purple in it. White Mountain paste is also quite distinctive, modally being gray with no gradation to the red surface and containing readily visible pieces of white sherd temper.

The derived series groups occur with greater frequency in different time periods. San Juan-tempered redwares dominate the A.D. 900s and 1000s, but are replaced in the A.D. 1000s by the sandstone and general groups, which are mostly White Mountain and Tsegi types. By group defininition, Woodruff is only in early contexts. Woodruff Red is a type originally defined by Mera and used since with little refinement. Woodruff Red has a brownware paste tempered with fine-to-medium sand, although Mera's description includes some coarse-tempered cases, as does the group called Woodruff here. Vessels are built by coiling (unlike Adamana Brown which is paddle-and-anvil). A deep red-to-grayish-red slip is applied to either the interior or both surfaces of bowls. No painted decoration is present. Slip is moderately polished, perhaps slightly better on bowl interiors. Although jars have not been recognized by others, this sorting class contains substantial numbers of closed vessels. In this instance this group should have a less rather than a more specific name, such as early red or brownware, especially with post-sorting inclusion by attributes. Whatever it is called, this sizable group of early red vessels should be separated from the other redwares and certainly bears further study.

With the exception of the early, plain redwares (especially "Woodruff") more than three-fourths of the redwares are bowls. This predominance of bowls probably results from preference for redwares as serving vessels, and perhaps also from relative ease of importing bowls rather than closed forms (Whittlesey 1974). The San Juan Redwares include a higher percentage of closed forms than the other groups, but are still over three-fourths bowls. The generally later "sandstone" group bowls tend to be larger than the other groups (Figure 2A.21). While there is no suggestion of stackable sizes in the overall redware bowl diameters (Figure 2A.22), there are four distinct peaks about 3 cm apart in the San Juan Redware bowls (Figure 2A.23). This group includes a broad time range, but the size groups are at least suggestive of transportable groups.

Hachure is much more common in the sandstone group than in the other groups. This results from the date of the majority of these specimens and the presence of Wingate Black-on-red. Parallel lines are especially abundant in the San Juan group, with wide Sosi style in the sandstone group (primarily Puerco Black-on-red). Because of greater inclusion of non-rim sherds in the analysis, there is a high proportion of sherds with unknown rim decoration; among the observable cases the San Juan group exhibits a greater tendency to have solid painted rims. Most of the decorated redwares are well polished and slipped.

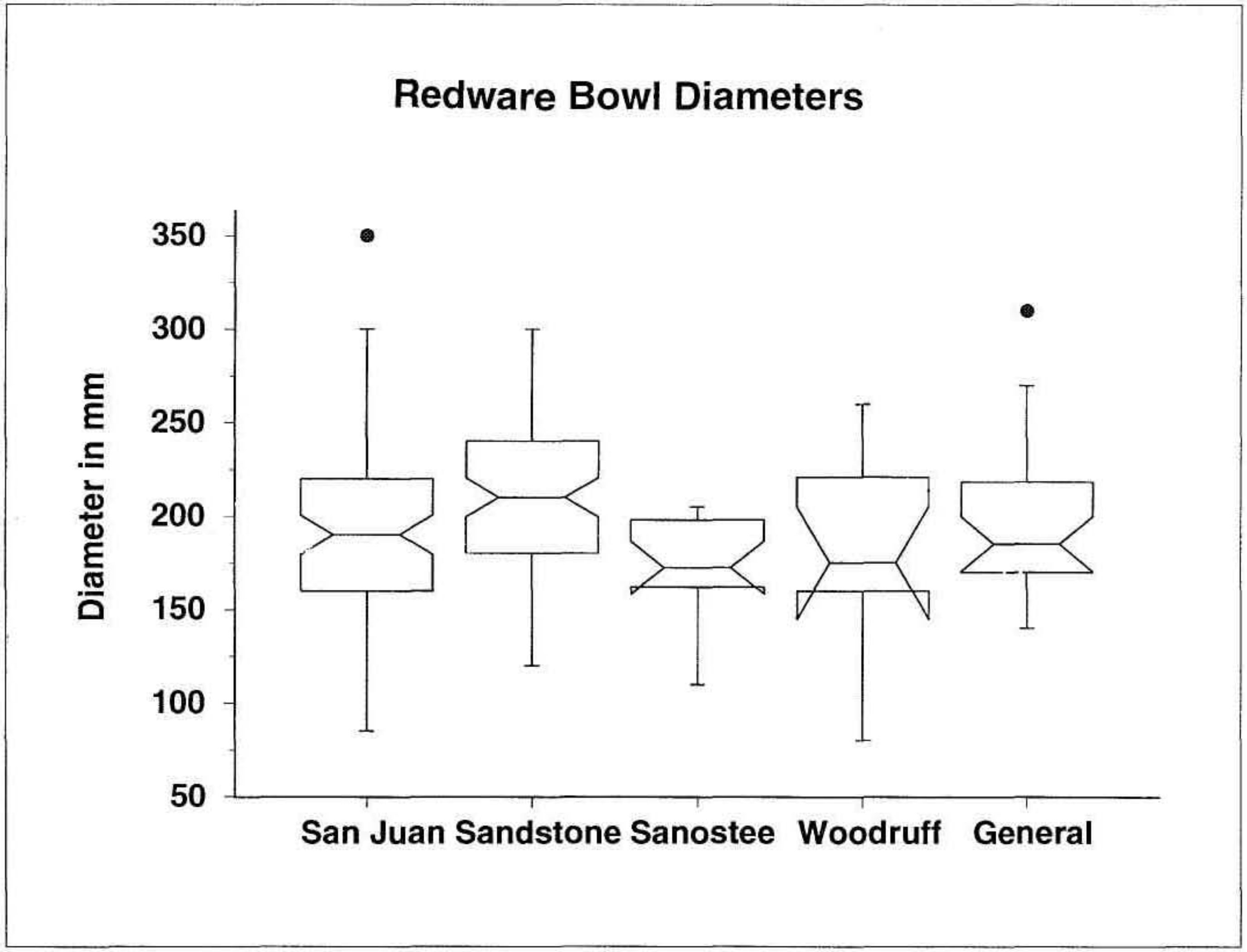


Figure 2A.21. Box plot of redware bowl diameters by type group. Group n's may be found in Table 2A.32.5.

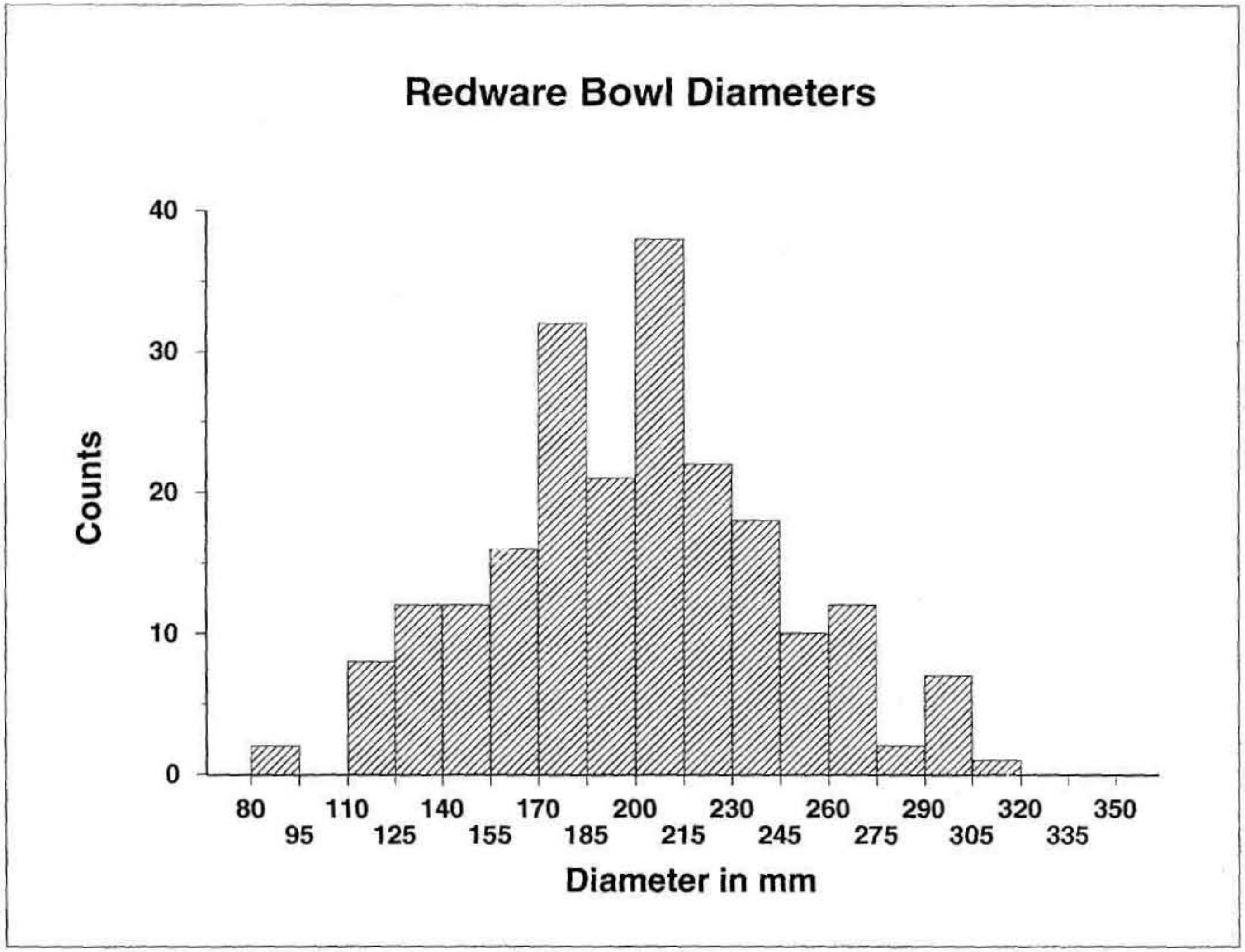


Figure 2A.22. Histogram showing distribution of all redware bowl diameters (n=214).

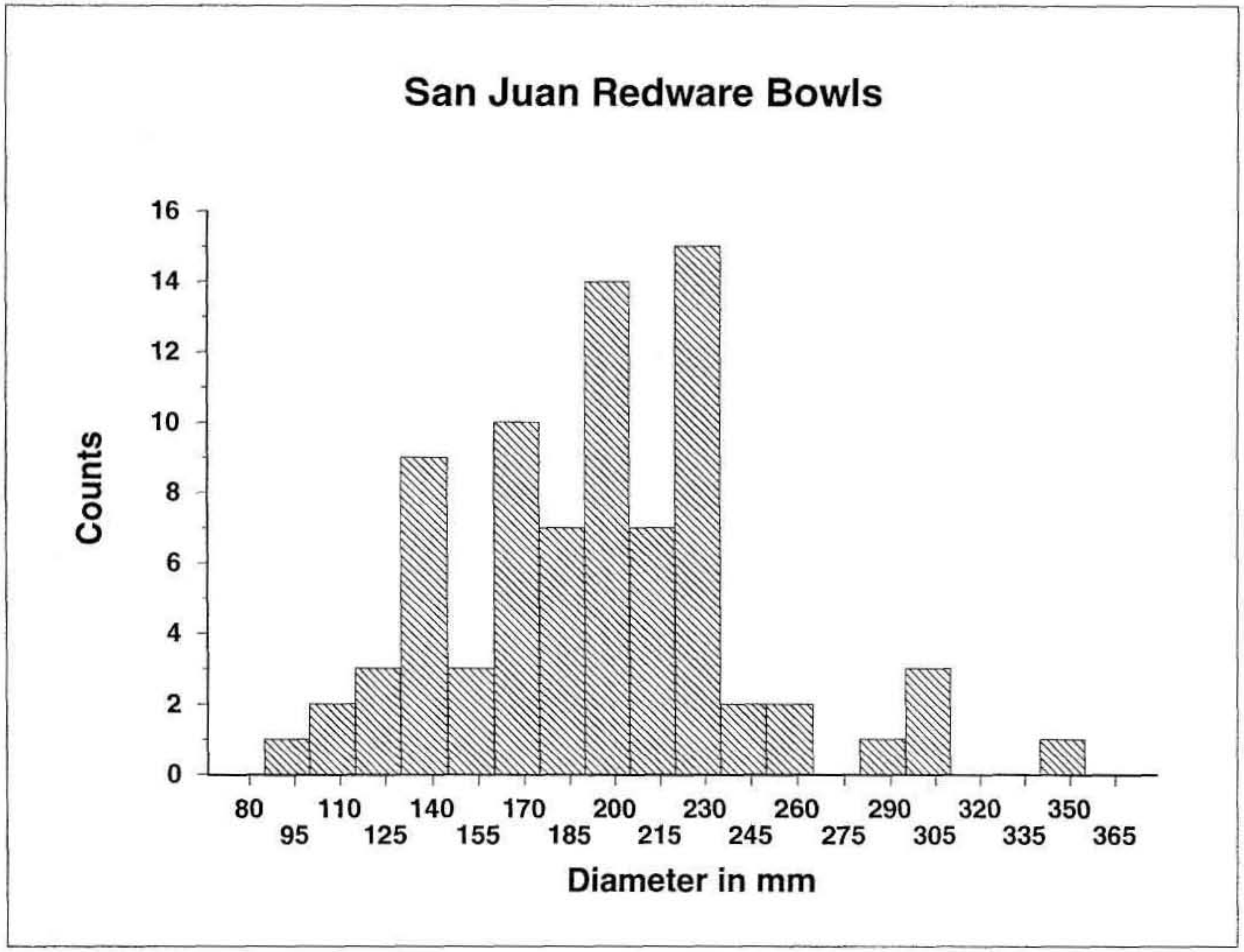


Figure 2A.23. Histogram of San Juan Redware bowl diameters from all time periods (n=80).

Table 2A.32. Redware definition.

Site occurrence: Original type names

	Ceramic Rough Sort Type								
	Plain Redware		Decorated Redware		Polychrome		Total		
Site No.	No.	% of Type	No.	% of Type	No.	% of Type	No.	% of Total	% of Site
29SJ 299 BMIII	-	-	1	0.3	-	-	1	0.2	0.2
29SJ 299 PI	-	-	9	2.4	-	-	9	1.8	3.6
Pueblo Alto	4	3.1	125	33.8	4	50.0	133	26.3	2.5
29SJ 423	88	69.3	-	-	-	-	88	17.4	13.8
29SJ 627	2	1.6	135	36.5	-	-	137	27.1	1.8
29SJ 628	7	5.5	1	0.3	-	-	8	1.6	0.9
29SJ 629	7	5.5	34	9.2	-	-	41	8.1	2.4
29SJ 633	1	0.8	12	3.2	4	50.0	17	3.4	5.3
29SJ 721	2	1.6	1	0.3	-	-	3	0.6	2.1
29SJ 724	14	11.0	29	7.8	-	-	43	8.5	7.9
29SJ 1360	1	0.8	23	6.2	-	-	24	4.8	1.2
Shabik'eshchee	1	0.8	-	-	-	-	1	0.2	0.5
Total	127	100.0	370	100.0	8	100.0	505	100.0	2.5

Original type by derived type

	Original Redware Series							
	Plain Redware		Decorated Redware		Polychrome		Total	
Derived Series	No.	%	No.	%	No.	%	No.	%
San Juan	11	8.7	180	48.6	-	-	191	37.8
Sandstone	12	9.4	117	31.6	8	100.0	137	27.1
Sanostee	6	4.7	29	7.8	-	-	35	6.9
Woodruff	79	62.2	-	-	-	-	79	15.6
General	19	15.0	44	11.9	-	-	63	12.5
Total	127	100.0	370	99.9	8	100.0	505	99.9

Table 2A.32. (continued)

Chaco Redwares by Time

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Time (A.D.)	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time	No.	% of Time	No.	%
500-600s	1	1.1	-	-	-	-	75	86.2	11	12.6	87	22.6
700-820	19	35.2	12	22.2	16	29.6	4	7.4	3	5.6	54	14.0
820-920	6	60.0	1	10.0	3	30.0	-	-	-	-	10	2.6
920-1040	86	74.1	12	10.3	10	8.6	-	-	8	6.9	116	30.1
1040-1100	28	45.2	5	8.1	-	-	-	-	29	46.8	62	16.1
1100-1200	1	1.8	54	96.4	-	-	-	-	1	1.8	56	14.5
Totals	141	36.6	84	21.8	29	7.5	79	20.5	52	13.5	385	100.0

Site Occurrence: Redwares divided by temper and time attributes

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Site No.	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
29SJ 299 BMIII	1	0.5	-	-	-	-	-	-	-	-	1	0.2
29SJ 299 PI	5	2.6	2	1.5	2	5.7	-	-	-	-	9	1.8
Pueblo Alto	36	18.8	64	46.7	-	-	-	-	33	52.4	133	26.3
29SJ 433	1	0.5	1	0.7	-	-	74	93.7	12	19.0	88	17.4
29SJ 627	87	45.5	36	26.3	9	25.7	-	-	5	7.9	137	27.1
29SJ 628	1	0.5	7	5.1	-	-	-	-	-	-	8	1.6
29SJ 629	22	11.5	6	4.4	8	22.9	-	-	5	7.9	41	8.1
29SJ 633	5	1.6	11	8.0	-	-	-	-	1	1.6	17	3.4
29SJ 721	-	-	3	2.2	-	-	-	-	-	-	3	0.6
29SJ 724	17	8.9	5	3.6	15	42.9	4	5.1	2	3.2	43	8.5
29SJ 1360	16	8.4	2	1.5	1	2.9	-	-	5	7.9	24	4.8
Shabik'eschee	-	-	-	-	-	-	1	1.3	-	-	1	0.2
Totals	191	100.0	137	100.0	35	100.0	79	100.0	63	100.0	505	100.0

Table 2A.32. (continued)

A. SURFACE TREATMENT

1. Decoration (all three design elements combined)

	Derived Redware Series									
	San Juan		Sandstone		Sanostee		General		Total	
Designs	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Non-overlapping steps	1	0.6	-	-	-	-	-	-	1	0.3
Parallel lines	37	22.2	13	8.7	2	8.3	13	27.1	65	16.8
Cribbed parallel lines	1	0.6	1	0.7	-	-	1	2.1	3	0.8
Banded framers	2	1.2	-	-	-	-	-	-	2	0.5
Pendant parallel lines	3	1.8	7	4.7	1	4.2	2	4.2	13	3.4
Framers with unticked solids	2	1.2	-	-	-	-	-	-	2	0.5
Irregular wide lines	2	1.2	-	-	-	-	-	-	2	0.5
Ticking	4	2.4	-	-	1	4.2	-	-	5	1.3
Corner triangles	2	1.2	2	1.3	-	-	2	4.2	6	1.5
Scrolls	6	3.6	3	2.0	-	-	-	-	9	2.3
Dotted lines	1	0.6	2	1.3	-	-	-	-	3	0.8
Thick wavy lines	1	0.6	1	0.7	-	-	-	-	2	0.5
Checkerboard	1	0.6	2	1.3	-	-	-	-	3	0.8
Eyed solids	-	-	1	0.7	-	-	-	-	1	0.3
Sawteeth	1	0.6	3	2.0	1	4.2	2	4.2	7	1.8
Barbs	1	0.6	9	6.0	3	12.5	-	-	13	3.4
Wide Sosi style	10	6.0	21	14.1	-	-	-	-	31	8.0
Narrow Sosi style	14	8.4	4	2.7	2	8.3	1	2.1	21	5.4
Heavy curvilinear lines	3	1.8	4	2.7	2	8.3	-	-	9	2.3
Narrow curvilinear lines	4	2.4	4	2.7	-	-	1	2.1	9	2.3
Solid band design	6	3.6	2	1.3	-	-	-	-	8	2.1
Isolated triangles	1	0.6	1	0.7	-	-	-	-	2	0.5
General solids	31	18.6	22	14.8	9	37.5	9	18.8	71	18.3
Bold bisecting lines	-	-	1	0.7	2	8.3	-	-	3	0.8
Hachure A-1	8	4.8	-	-	-	-	5	10.4	13	3.4
Hachure A-3	3	1.8	7	4.7	-	-	-	-	10	2.6
Hachure B-1	1	0.6	12	8.1	-	-	1	2.1	14	3.6
Hachure B-3	-	-	4	2.7	-	-	-	-	4	1.0

Table 2A.32. (continued)

	Derived Redware Series									
	San Juan		Sandstone		Sanostee		General		Total	
Designs	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Hachure B-4	-	-	2	1.3	-	-	-	-	2	0.5
Hachure B-6	1	0.6	2	1.3	-	-	-	-	3	0.8
Heavy Gallup squiggle	1	0.6	-	-	-	-	2	4.2	3	0.8
Hatched pendant triangles	1	0.6	-	-	-	-	-	-	1	0.3
Squiggle lines	3	1.8	-	-	-	-	1	2.1	4	1.0
Interlocked frets	-	-	2	1.3	-	-	-	-	2	0.5
Solid ticked triangles	3	1.8	1	0.7	-	-	-	-	4	1.0
Exterior bowl motif	1	0.6	-	-	-	-	1	2.1	2	0.5
Jar neck motif	1	0.6	-	-	1	4.2	1	2.1	3	0.8
White exterior design polychrome	-	-	4	2.7	-	-	-	-	4	1.0
Unslipped motif area polychrome	1	0.6	4	2.7	-	-	-	-	5	1.3
Interlocked ticking	-	-	1	0.7	-	-	-	-	1	0.3
Other hatched	9	5.4	7	4.7	-	-	6	12.5	22	5.7
Total	167	100.0	149	100.0	24	100.0	48	100.0	388	100.0
No. with 1 painted treatment	134	80.2	107	71.8	20	83.3	37	77.1	298	76.8
No. with 2 painted treatments	27	16.2	38	25.5	4	16.7	11	22.9	80	20.6
No. with 3 painted treatments	6	3.6	4	2.7	0		0		10	2.6

2. Paint

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Type	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Unpainted	26	13.6	25	18.2	8	22.9	78	98.7	22	34.9	159	31.5
Mineral: red	-	-	-	-	-	-	1	1.3	-	-	1	0.2
black	1	0.5	2	1.5	-	-	-	-	-	-	3	0.6
glaze	2	1.0	-	-	-	-	-	-	-	-	2	0.4
Mineral-Carbon	160	83.8	106	77.4	27	77.1	-	-	40	63.5	333	65.9
Carbon	1	0.5	4	2.9	-	-	-	-	-	-	5	1.0
Unknown	1	0.5	-	-	-	-	-	-	1	1.6	2	0.4
Totals	191	100.0	137	100.0	35	100.0	79	100.0	63	100.0	505	100.0

Table 2A.32. (continued)

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Rim Decoration	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Unpainted	37	19.4	83	60.6	10	28.6	27	34.2	19	30.2	176	34.9
Solid	69	36.1	16	11.7	8	22.9	1	1.3	16	25.4	110	21.8
Eroded paint	6	3.1	2	1.5	2	5.7	-	-	1	1.6	11	2.2
Use-ground	5	2.6	2	1.5	-	-	-	-	-	-	7	1.4
Unknown	74	38.7	34	24.8	15	42.9	51	64.6	27	42.9	201	39.8
Totals	191	100.0	137	100.0	35	100.0	79	100.0	63	100.0	505	100.0

Table 2A.32. (continued)

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	16	4.0	7	6.9	23	4.6
None	7	1.8	2	2.0	9	1.8
One side						
Streaky	1	0.3	2	2.0	3	0.6
Moderate	1	0.3	5	5.0	6	1.2
Completely polished	29	7.3	69	68.3	98	19.7
Both sides						
Streaky	2	0.5	2	2.0	4	0.8
Moderate	5	1.3	-	-	5	1.0
Completely polished	322	81.1	13	12.9	335	67.3
Differential interior/exterior polish	14	3.5	1	1.0	15	3.0
Totals	397	100.0	101	100.0	498	100.0

4. Slip

	Grouped Forms					
	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	71	17.9	29	28.7	100	20.1
Interior	37	9.3	-	-	37	7.4
Exterior	9	2.3	61	60.4	70	14.1
Slipslop	1	0.3	2	2.0	3	0.6
Both sides	270	68.0	8	7.9	278	55.8
Unknown	9	2.3	1	1.0	10	2.0
Totals	397	100.0	101	100.0	498	100.0

Table 2A.32. (continued)

5. Forms and Metrics

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Form	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Bowl	148	77.5	121	88.3	31	88.6	41	51.9	51	81.0	392	77.6
Ladle	4	2.1	1	0.7	-	-	-	-	-	-	5	1.0
Jar	25	13.1	7	5.1	2	5.7	32	40.5	6	9.5	72	14.3
Pitcher	2	1.0	-	-	1	2.9	-	-	1	1.6	4	0.8
Olla	-	-	-	-	-	-	1	1.3	-	-	1	0.2
Canteen	-	-	-	-	-	-	-	-	1	1.6	1	0.2
Seed jar	4	2.1	4	2.9	-	-	-	-	1	1.6	9	1.8
Tecomate	3	1.6	3	2.2	1	2.9	3	3.8	1	1.6	11	2.2
Duck pot	1	0.5	-	-	-	-	-	-	-	-	1	0.2
Effigy	-	-	1	0.7	-	-	-	-	1	1.6	2	0.4
Unknown	4	2.1	-	-	-	-	2	2.5	1	1.6	7	1.4
Totals	191	100.0	137	100.0	35	100.0	79	100.0	63	100.0	505	100.0

	Orifice Diameter			
Form	No.	Range	x̄	s.d.
Bowl	214	80-350	197.5	45.79
San Juan	80	85-350	191.9	48.33
Sandstone	81	120-300	209.8	43.42
Sanostee	16	110-205	173.8	27.11
Woodruff	10	80-260	177.0	52.72
General	27	140-310	198.5	42.69
Ladle (San Juan)	4	85-130	106.3	22.13
Jar	7	30-90	67.9	21.96

Table 2A.32. (continued)

	Orifice Diameter			
Form	No.	Range	$\bar{x}$	s.d.
San Juan	2	-	55.0	7.07
Sandstone	1	-	85.0	0.00
Woodruff	4	-	70.0	27.80
Pitcher	4	70-70	70.0	0.00
San Juan	2	-	70.0	0.00
Sanostee	1	-	70.0	0.00
General	1	-	70.0	0.00
Olla (Woodruff)	1	-	205.0	0.00
Canteen (General)	1	-	30.0	0.00
Seed jar	7	90-210	129.3	38.99
San Juan	4	-	116.2	9.46
Sandstone	3	-	146.7	60.28
Tecomate	6	70-160	96.7	32.20
San Juan	1	-	95.0	0.00
Sandstone	2	-	122.5	53.03
Sanostee	1	-	80.0	0.00
Woodruff	1	-	90.0	0.00
General	1	-	70.0	0.00
Effigy (sandstone)	1	-	15.0	0.00

Table 2A.32. (continued)

6. Handles

	Derived Redware Series									
	San Juan		Sandstone		Sanostee		General		Total	
	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Solid coil	3	33.3	-	-	-	-	-	-	3	20.0
Multiple solid coil	1	11.1	-	-	-	-	1	100.0	2	13.3
Strap	2	22.2	1	25.0	1	100.0	-	-	4	26.7
Tubular	1	11.1	-	-	-	-	-	-	1	6.7
Nubbin	-	-	1	25.0	-	-	-	-	1	6.7
Solid tabular lugs	1	11.1	-	-	-	-	-	-	1	6.7
Perforated lugs	-	-	1	25.0	-	-	-	-	1	6.7
Bifurcated solid	-	-	-	-	-	-	-	-	-	-
Tabular lugs	1	11.1	-	-	-	-	-	-	1	6.7
Effigy handles	-	-	1	25.0	-	-	-	-	1	6.7
Totals	9	100.0	4	100.0	1	100.0	1	100.0	15	100.0

7. Surface Alteration

Blackened sherds = 4 (0.8%).
Worked sherds = 69 (13.7%).

Table 2A.32. *(continued)*

B. PASTE

1. Temper Composition

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Temper	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Fine to medium sandstone > sherd			16	11.7	-	-	30	38.0	-	-	46	9.5
Fine to medium sandstone < sherd	-	-	83	60.6	-	-	-	-	-	-	83	17.2
Coarse sandstone > sherd	-	-	11	8.0	-	-	37	46.8	-	-	48	9.9
Coarse sandstone < sherd	-	-	23	16.8	-	-	-	-	-	-	23	4.8
Chalcedonic sandstone	-	-	1	0.7	-	-	1	1.3	-	-	2	0.4
Sandstone with rounded iron oxide	-	-	3	2.2	-	-	11	13.9	-	-	14	3.1
Trachyte	-	-	-	-	33	94.3	-	-	-	-	33	7.3
No. with sandstone	-	-	-	-	2	5.7	-	-	-	-	2	0.4
San Juan igneous with hornblende	98	51.3	-	-	-	-	-	-	-	-	98	21.6
San Juan igneous without hornblende	48	25.1	-	-	-	-	-	-	-	-	48	10.6
Sandstone-San Juan igneous with hornblende	1	0.5	-	-	-	-	-	-	-	-	1	0.2
San Juan igneous with hornblende and sandstone	25	13.1	-	-	-	-	-	-	-	-	25	5.5
San Juan igneous without hornblende and sandstone	19	9.9	-	-	-	-	-	-	-	-	19	4.2
Unidentified igneous	-	-	-	-	-	-	-	-	2	18.2	2	0.4
Unidentified igneous with sandstone	-	-	-	-	-	-	-	-	1	9.1	1	0.2
Sandstone-unidentified igneous	-	-	-	-	-	-	-	-	3	27.3	3	0.7
Not observed	-	-	-	-	-	-	-	-	5	45.5	5	1.1
Totals	191	100.0	137	100.0	35	100.0	79	100.0	11	100.0	453	100.0

Table 2A.32. (continued)

2. Texture Attributes

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Grain Size	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Very fine	31	16.2	24	17.5	-	-	15	19.0	2	20.0	72	16.1
Fine	1	0.5	-	-	1	2.9	-	-	-	-	2	0.4
Medium	108	56.5	75	54.7	15	42.9	17	21.5	4	40.0	219	48.9
Coarse	5	2.6	10	7.3	4	11.4	3	3.8	-	-	22	4.9
Very coarse	46	24.1	28	20.4	15	42.9	44	55.7	-	-	133	29.7
Totals	191	100.0	137	100.0	35	100.0	79	100.0	6	100.0	448	100.0

	Derived Redware Series									
	San Juan		Sandstone		Sanostee		Woodruff		Total	
Density	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
1-2%	1	0.6	-	-	-	-	1	1.3	2	0.5
5%	5	3.2	4	3.4	1	5.6	7	9.3	17	4.6
10%	34	22.1	44	37.0	11	61.1	34	45.3	123	33.6
20%	80	51.9	64	53.8	6	33.3	18	24.0	168	45.9
30%	34	22.1	7	5.9	-	-	11	14.7	52	14.2
>40%	-	-	-	-	-	-	4	5.3	4	1.1
Totals	154	100.0	119	100.0	18	100.0	75	100.0	366	100.0

Table 2A.32. (continued)

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Sherd Temper	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
None	169	88.5	20	14.6	35	100.0	77	97.5	2	20.0	303	67.0
< half	16	8.4	11	8.0	-	-	2	2.5	2	20.0	31	6.9
> half	6	3.1	66	48.2	-	-	-	-	2	20.0	74	16.4
All	-	-	40	29.2	-	-	-	-	-	-	40	8.8
Not observed	-	-	-	-	-	-	-	-	4	40.0	4	0.9
Totals	191	100.0	137	100.0	35	100.0	79	100.0	10	100.0	452	100.0

3. Clay Attributes

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Clay-Temper Types	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
No type	150	96.8	43	36.1	14	77.8	35	46.7	3	60.0	245	65.9
Black paste with white sherd	1	0.6	7	5.9	-	-	-	-	-	-	8	2.2
Gray with black sherd	-	-	16	13.4	-	-	-	-	-	-	16	4.3
Black and white sherd temper	1	0.6	30	25.2	-	-	-	-	-	-	31	8.3
Little Colorado	-	-	1	0.8	-	-	-	-	-	-	1	0.3
Chuska gray	-	-	-	-	3	16.7	-	-	-	-	3	0.8
Gray paste with white sherd	-	-	15	12.6	-	-	-	-	1	20.0	16	4.3
Tan	3	1.9	6	5.0	1	5.6	37	49.3	1	20.0	48	12.9
White	-	-	1	0.8	-	-	3	4.0	-	-	4	1.1
Totals	155	100.0	119	100.0	18	100.0	75	100.0	5	100.0	372	100.0

Table 2A.32. (continued)

	Derived Redware Series											
	San Juan		Sandstone		Sanostee		Woodruff		General		Total	
Vitrification	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Ware	No.	% of Total
Absent	51	27.7	26	20.8	19	57.6	31	40.3	3	50.0	130	30.6
Present	60	32.6	72	57.6	5	15.2	42	54.5	2	33.3	181	42.6
Marked	73	39.7	27	21.6	9	27.3	4	5.2	1	16.7	114	26.8
Totals	184	100.0	125	100.0	33	100.0	77	100.0	6	100.0	425	100.0

Polychrome

References: Abel (1956); Carlson (1970), Colton (1956)

Included types:

White Mountain Redware: Wingate Polychrome, St. Johns Polychrome
Tsegi: Tusayan Polychrome, Citadel Polychrome, Cameron Polychrome

Production span:

Wingate Polychrome: A.D. 1075 to 1200
St. Johns Polychrome: A.D. 1175 to 1300
Tusayan Polychrome: A.D. 1050 to 1130
Cameron Polychrome: A.D. 1075 to 1200
Citadel Polychrome: A.D. 1100 to 1200

Table: 2A.32

Description:

Polychrome sherds are extremely rare in the Chaco Project assemblage; there are only eight in the detailed analysis, evenly split between White Mountain Redwares and Tsegi Orangewares. The polychrome effect is achieved differently in these two series. White Mountain Polychromes are created by slip treatments on the exterior; in Wingate Polychrome, slip is applied differentially to the exterior of bowls, while in St. Johns Polychrome, white slip designs are applied over the full red slip on bowl exteriors. The Tsegi Polychromes are achieved by the use of red and black paints over the orange paste on bowl interiors.

Plain Red

References: Abel (1955); Carlson (1970); Colton (1956); Daifuku (1961); Haury (1940); Peckham and Wilson (1964)

Included types (undecorated portions only):

Woodruff Red (Forestdale)
Chuska: Sanostee Black-on-red
Mesa Verde: Abajo Red-on-orange, Bluff, Deadmans Black-on-red
White Mountain Redware: Puerco, Wingate Black-on-Reds; Wingate, St. Johns Polychromes
Tusayan: Tallahogan Red
Tsegi Orangeware: Tsegi Orange

Production span: Woodruff: pre-A.D. 800

Table: 2A.32

Description:

This group of sherds lacks decoration, preventing their placement in other type groups. As is true of the black-on-red group, the temper allows many of them to be placed into general series and region of production. They are included in the redware tables. Plain red contains two categories of vessel: early unpainted utility jars, and undecorated portions of later decorated redware vessels. Well over 80 percent of the plain red sherds come from early contexts, primarily the Basketmaker III-Pueblo I sites, 29SJ 423 and 29SJ 724. These are probably the only red utility jars, late Tsegi Orange utility wares (see Beals et al. 1945:127) being absent. The red pottery from 29SJ 423, some of the earliest in the project collections, is dark reddish-brown on the exterior, tending toward thick walls with rough surfaces.

BROWNWARES

Polished Smudged

References: Haury (1940); Mera (1934); Nesbitt (1938)

Included types:

Lino Smudged
Woodruff Smudged
Forestdale Smudged
Reserve or Upper Gila Smudged Corrugated
Showlow Smudged
Los Lunas Smudged

Production span: A.D. 500? to 1200

Table: 2A.33

Description:

Vessels in this group are nearly all bowls. These vessels have very highly polished interiors which have been smudged in firing to a lustrous black. The great majority of such vessels represented in the Chaco Project collections have a polished, red-brown exterior, but a few are corrugated, and some early examples (Lino Smudged) are unpolished. Although Roberts (1927:116) was convinced that "redwares with polished black interior" were local products, we are quite certain that all but the earliest—Lino Smudged—were made to the south and southwest in the Mogollon area. Very red oxidation colors in refiring tests show that the clays used in these types are distinct from those used in pottery made in the San Juan Basin (McKenna 1992:504-508; McKenna and Toll 1984:154-155; Toll and McKenna 1992:150-153). In spite of its relatively distant source, polished smudged pottery is present in all time segments and at all the project sites. As with redwares, then, polished smudged bowls seem to have been an expected part of the ceramic assemblage.

In the main analysis, all polished smudged specimens were placed in a single group, although McKenna conducted separate studies with greater typological refinement (McKenna 1992; Toll and McKenna 1987:158-159). The majority of polished smudged sherds are Forestdale Smudged with plain polished exteriors (there are 12 vessels with corrugated exteriors). Most of these vessels have fine sand temper. Examples of Showlow Smudged appear in later contexts; this group is distinguished by more sherd temper and slipping. Lino Smudged has gray, unpolished exteriors and tends to coarser sand temper with no sherd temper present. Of an expanded sample of 114 refired polished smudged wares from 29SJ 627, 57.9 percent were Forestdale Smudged, 28.1 percent Showlow Smudged, 7.0 percent Woodruff or Forestdale Smudged, 3.5 percent Upper Gila Corrugated, and 3.5 percent Lino Smudged (McKenna 1992).

Table 2A.33. Polished Smudged definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
29SJ 299 BMIII	6	1.5	1.2
29SJ 299 PI	1	0.3	0.4
Pueblo Alto	130	33.2	2.4
29SJ 423	32	8.2	5.0
29SJ 627	76	19.4	1.0
29SJ 628	39	10.0	4.5
29SJ 629	20	5.1	1.2
29SJ 633	1	0.3	0.3
29SJ 721	8	2.0	5.6
29SJ 724	49	12.5	9.0
29SJ 1360	22	5.6	1.1
Shabik'eschee	7	1.8	3.6
Total	391	100.0	1.9

A. SURFACE TREATMENT

	Motif No.				
Designs	1	2	3	No.	%
Unpolished plain	8	-	-	8	2.0
Polished plain	379	-	-	379	94.8
Narrow neckbanded 2-5 mm	-	1	-	1	0.2
Narrow corrugated 2-5 mm	4	6	-	10	2.5
Corrugated, flattened	-	-	1	1	0.2
Hooks, flags	-	1	-	1	0.2
Totals	391	8	1	400	99.9
No. with 1, 2, 3 treatments	38 3	7	1	391	-
% with 1, 2, 3 treatments	98.0	1.8	0.2	-	100.0

Type Design Diversity H' = 0.258
s = 6 J = 0.144
Design Distribution Diversity H' = 0.105
s = 3 J = 0.095

2. Paint

Type	No.	%
Unpainted	391	100.0
Total	391	

Rim Decoration	No.	%
Unpainted	306	78.3
Ground	1	0.3
Unknown	84	21.5
Total	391	100.1

Table 2A.33. (continued)

3. Polish

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Unknown	4	1.1	-	-	4	1.0
None	5	1.3	3	25.0	8	2.1
One side						
Streaky	1	0.3	-	-	1	0.3
Moderate	3	0.8	1	8.3	4	1.0
Completely polished	69	18.3	5	41.7	74	19.0
Both sides						
Streaky	1	0.3	1	8.3	2	0.5
Moderate	3	0.8	-	-	3	0.8
Completely polished	270	71.5	2	16.7	272	69.7
Differential interior/exterior polish	22	5.8	-	-	22	5.6
Totals	378	100.2	12	100.0	390	100.0

*Less unknown forms n = 1.

4. Slip

	Open		Closed		Total	
Type	No.	%	No.	%	No.	%
Absent	319	84.4	12	100.0	331	84.9
Interior	1	0.3	-	-	1	0.3
Exterior	2	0.5	-	-	2	0.5
Slipslop	-	-	-	-	-	-
Both sides	55	14.6	-	-	55	14.1
Unknown	1	0.3	-	-	1	0.3
Totals	378	100.1	12	100.0	390	100.1

5. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	376	96.2	217	40-350	-	-	-
Ladle	2	0.5	2	50- 85	67.5	24.749	36.7
Jar	11	2.8	1	75	-	-	-
Pitcher	1	0.3	1	90	-	-	-
Unknown	1	0.3					
Total	391	100.1					

Forms Diversity H' = 0.178
s = 4 J = 0.129

6. Handles

Type	No.	%
Trough	1	50.00
Dual nubbin	1	50.00
Total	2	100.00

7. Surface Alteration

Worked sherds = 27 (6.9%).

Table 2A.33. (continued)

B. PASTE

1. Temper Composition

Temper	No.	% of Total
Undifferentiated sandstone (n=300, 88.7%)		
Fine to medium sandstone > sherd	122	40.7
Fine to medium sandstone < sherd	116	38.7
Coarse sandstone > sherd	54	18.0
Coarse sandstone < sherd	8	2.7
All chalcedonic sandstone*	2	0.6
Sandstone with rounded iron oxide	2	0.6
Magnetitic sandstone	10	3.0
Trachyte	1	0.3
San Juan igneous without hornblende	1	0.3
Unidentified igneous + sandstone	4	1.2
Sandstone + unidentified igneous	18	5.3
Total	338	100.0

*Variety specified: white n = 2

Temper Diversity H' = 0.514
s = 8 J= 0.247

2. Texture Attributes

Grain Size	No.	%
Fine	142	41.9
Medium	129	38.1
Coarse	53	15.6
Very coarse	15	4.4
Total	339	100.0

Density	No.	%
1-2%	3	1.3
5%	10	4.3
10%	46	19.9
20%	99	42.9
30%	61	26.4
>40%	12	5.2
Total	231	100.0

Sherd Temper	No.	%
None	140	41.2
<half	62	18.2
>half	120	35.3
All	18	5.3
Total	340	100.0

Unidentified Sandstone Grain Size	No.	%
Fine	104	37.0
Medium	126	44.8
Coarse	37	13.2
Very coarse	14	5.0
Total	281	100.0

Texture Index	No.	%
Very fine (0-2)	72	35.8
Fine (2.1-4)	70	34.8
Fine-medium (4.1-7)	47	23.4
Medium (7.1-10)	5	2.5
Medium-coarse (10.1-13)	1	0.5
Coarse (13.1-16)	4	2.0
Very coarse (16.1+)	2	1.0
Total	201	100.0

Table 2A.33. (continued)

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	77	33.0
Black with white sherd	19	8.1
Gray with black sherd	2	0.9
Gray with black and white sherd	8	3.4
Gray with white sherd	31	13.3
Little Colorado gray	2	0.9
Tan to brown clay	82	35.2
Black clay	10	4.3
White clay	2	0.9
Total	233	

Vitrification	No.	%
None	89	36.2
Present	111	45.1
Marked	46	18.7
Total	246	

Paste Diversity $H' = 1.580$
$s = 9$ $J = 0.719$

Other Brownwares
"Exotic Brownware"

References: Mera (1934); Rinaldo and Bluhm (1956); Wilson (1989)

Included types:

Sambrito Brown
Woodruff Brown
Reserve Indented Corrugated

Production span: A.D. 450 to 1200

Table: 2A.34

Description:

There are 75 vessels represented in the detailed analysis classified as "Exotic Brownware." As are most of the early plain redwares, most (88 percent) of the plain brownwares are from 29SJ 423, with just a few from some of the large site collections, and two from Shabik'eshchee. Given the early context, some of these may be "Sambrito Brown" (see Wilson 1989), an early Anasazi pottery made with self-tempered alluvial clays. All but one of the members of this group from 29SJ 423 and Shabik'eshchee are polished plainwares. The other possible source for early brownwares is the Mogollon area to the south and the southwest. The single corrugated brownware (found at Pueblo Alto) is doubtless from the Mogollon area. Nearly all of the sherds in this group are tempered with sand; the two with igneous temper again indicate a Mogollon provenance.

Table 2A.34. Brownware definition.

	Site Occurrence		
Site	No.	% of Type	% of Site
Pueblo Alto	3	4.0	0.1
29SJ 423	66	88.0	10.4
29SJ 627	3	4.0	0.4
29SJ 629	1	1.3	0.1
Shabik'eschee	2	2.7	1.0
Total	75	100.0	0.4

A. SURFACE TREATMENT

1. Decoration

	Motif No.			
Designs	1	2	No.	%
Unpolished plain	4	-	4	5.3
Polished plain	68	-	68	90.7
Narrow corrugated 2-5 mm	1	-	1	1.3
Mummy Lake style	1	-	1	1.3
Fingernail punctate	1	-	1	1.3
Totals	75	-	75	99.9

Type Design Diversity H' = 0.418
s = 5 J = 0.260

2. Sooting

Type	No.	%
Unsooted	70	100.0

3. Handles

Type	No.	%
Strap	6	33.3

Handles:items = 1:12

4. Forms and Metrics

			Orifice Diameter (mm)				
Form	No.	%	No.	Range	$\bar{x}$	s.d.	cv %
Bowl	17	22.7	1	140	-	-	-
Jar	47	62.7	4	40-180	93.8	65.744	70.1
Olla	1	1.3	1	90	-	-	-
Tecomate	1	1.3	1	100	-	-	-
Effigy	1	1.3	-	-	-	-	-
Miniature	1	1.3	1	40	-	-	-
Gourd jar	1	1.3	1	35	-	-	-
Unknown	6	8.0	-	-	-	-	-
Total	75	99.9					

Diversity of Forms H' = 0.914
s = 7 J = 0.469

5. Surface Alterations

Worked sherds = 5 (6.7%).

Table A.32. (continued)

B. PASTE

1. Temper Composition

Temper	No.	%
Undifferentiated sandstone (n=65, 94.2%)		
Fine to medium sandstone > sherd	58	84.1
Fine to medium sandstone < sherd	1	1.4
Coarse sandstone > sherd	6	8.7
Sandstone with rounded iron oxide	1	1.4
Magnetitic sandstone	1	1.4
Unidentified igneous with sandstone	2	2.9
Total	69	99.9

Temper Diversity H' = 0.282
s = 4 J = 0.203

2. Texture Attributes

Grain Size	No.	%
Fine	45	65.2
Medium	16	23.2
Coarse	7	10.1
Very coarse	1	1.5
Total	69	100.0

Density	No.	%
1-2%	-	-
5%	4	5.8
10%	10	14.5
20%	13	18.8
30%	23	33.3
>40%	19	27.5
Total	69	99.9

Sherd Temper	No.	%
None	64	92.8
< half	4	5.8
> half	1	1.4
Total	69	100.0

Undifferentiated Sandstone Grain Size	No.	%
Fine	44	67.7
Medium	15	23.1
Coarse	6	9.2
Very coarse	-	-
Total	65	100.0

Texture Index	No.	%
Very fine (0-2)	1	16.7
Fine (2.1-4)	1	16.7
Fine-medium (4.1-7)	2	33.3
Medium (7.1-10)	1	16.7
Medium-coarse (10.1-13)	-	-
Coarse (13.1-16)	-	-
Very coarse (16.1+)	1	16.7
Total	6	100.1

3. Clay Attributes

Clay-temper types	No.	%
No type assigned	36	52.2
Black with white sherd	1	1.5
Tan to brown clay	29	42.0
Black clay	2	2.9
White clay	1	1.5
Total	69	100.1

Vitrification	No.	%
None	8	11.6
Present	51	73.9
Marked	10	14.5
Total	69	100.0

Paste Diversity H' = 0.929
s = 5 J = 0.577

Appendix 2B

Chaco Project Ceramic Analysis Coding Keys

Ceramic Rough Sort

Provenience No.		No. of Col.	Column
001	Site Number	4	01-04
		1X	05-06
002	General Provenience Unit	2	06-07
003	Provenience Unit Number	3	08-10
		2X	11-12
004	General Level	1	13
005	Floor/subfloor Indicator	1	14
006	Layer/Level Number	4	15-18
007	Fill Characteristic	2	19-20
		1X	21
008	Feature Category	2	22-23
009	Feature Number	2	24-25
		1X	26
010	Feature Fill Category	1	27
		8X	28-35
011	Artifact Type/Ceramic Form	3	36-38
	(use prior coding conventions)	1X	39
012	Condition	1	49
	(use prior coding conventions)	1X	41
013	Material/Ceramic Type Category	2	42-43

1. Ceramic Type (Rough Sort)

A. Utility Wares

01	Plain Gray (unidentified)
02	Lino Gray
03	Wide Neckbanded
04	Narrow Neckbanded
05	PII Corrugated
06	PII-PIII Corrugated
07	PIII Corrugated
08	Unidentified Corrugated
09	Early PII Neck Corrugated

B. Plainwares

10	Lino Fugitive Red
11	Plain Redwares
12	Polished Tan/Gray
13	Polished Smudged (Brownware)
14	Unfired Mudwares
15	Exotic Brownwares

C. Decorated Wares (Mineral)

20	BMIII/PI Polished Mineral
21	BMIII/PI Unpolished Mineral
22	Early Red Mesa Black-on-white
23	Late Red Mesa Black-on-white
24	Escavada Black-on-white
25	Puerco Black-on-white
26	Gallup Black-on-white
27	Chaco Black-on-white
28	Exotic Mineral Black-on-white
29	Unidentified Whitewares
30	PII/PIII Mineral-on-white

D. Decorated Wares (Carbon)

40	BMIII/PI Polished Carbon
41	BMIII/PI Unpolished Carbon
42	PII/PIII Carbon, including San Juan series
43	Mesa Verde Black-on-white
44	Chaco-McElmo Black-on-white
45	Tusayan Whiteware—Sosi, Black Mesa, Dogoshi, etc.
46	Chuska Black-on-white
47	Other Chuskan Whiteware
48	Newcomb Black-on-white (Red Mesa style Chuskan wares—including Burnham)

E. Decorated Wares (Red)

50	Decorated Redware
51	Polychrome

F. Other

60	Historic/Navajo

014	Frequency per FS Number	12X	44-45
		4	56-59
		1X	60
015	FS Number	6	61-66
		8X	67-74

446 Chaco Artifacts

016	<u>Other Forms</u>	2	75-76
017	<u>Bowls</u>	2	77-78
018	<u>Jars</u>	2	79-80

Detailed Ceramic Analysis

Variable			Column
01	Site Number		1-3
02	General Provenience		4-5
03	General Provenience Number		6-8
04	General Level Category		10
05	Floor Indicator		11
06	Layer-Level Number		13-16
07	Level Characteristic		17
08	Feature Type		19-20
09	Feature Number		21-22
10	Feature Level Category		23
11	Vessel Form		26-27
	01	Bowl	
	02	Canteen	
	03	Duck pot	
	04	Effigy, feet, heads, etc.	
	05	Jar (if not listed as another jar form)	
	06	Ladle (including handle fragment, but not handle tip)	
	07	Ladle with handle tip/end	
	08	Mug as of 1 June 79	
	09	Pipe	
	10	Pitcher	
	11	Seed jar	
	12	Tecomate	
	13	Cylindrical vase	
	14	Olla	
	15	Miniature vessel	
	16	Gourd jars	
	99	Unknown	
12	Slip Location		29
	1	Absent	
	2	Interior only	
	3	Exterior only	
	4	Lip slope (just below rim on bowl exterior, jar interior)	
	5	Interior and exterior	
	6		
	9	Unknown	
13	Polish		30
	1	None	
	2	Streaky	
	3	Moderate	
	4	Total (90-100%)	

5 Streaky }
6 Moderate } interior and exterior bowls and ladles
7 Total }
8 Total interior, moderate to streaky exterior (bowls only)
9 Unknown

14 Paint Type 31

1 Unpainted
2 Mineral red
3 Mineral brown
4 Mineral black
5 Mineral green
6 Mineral/carbon (all redwares)
7 Carbon
8 Glaze
9 Unknown (paint present)

15 Rim Decoration (Figure 2B.1) 32

1 Unpainted
2 Painted solid
3 Painted dots or dashes
4 Eroded but exhibits paint
5 Ground from use, removing paint
6 Ground and remaining unground rim, unpainted
7 Ground and remaining unground rim, painted solid
8 Ground and remaining unground rim, with dots and dashes
9 Unknown

Figure 2B.1. Rim decorations.

16 Rough Sort Type (see rough sort form) 34-35

17 Design Element #1 37-39

18 Design Element #2 40-42

19 Design Element #3 43-45

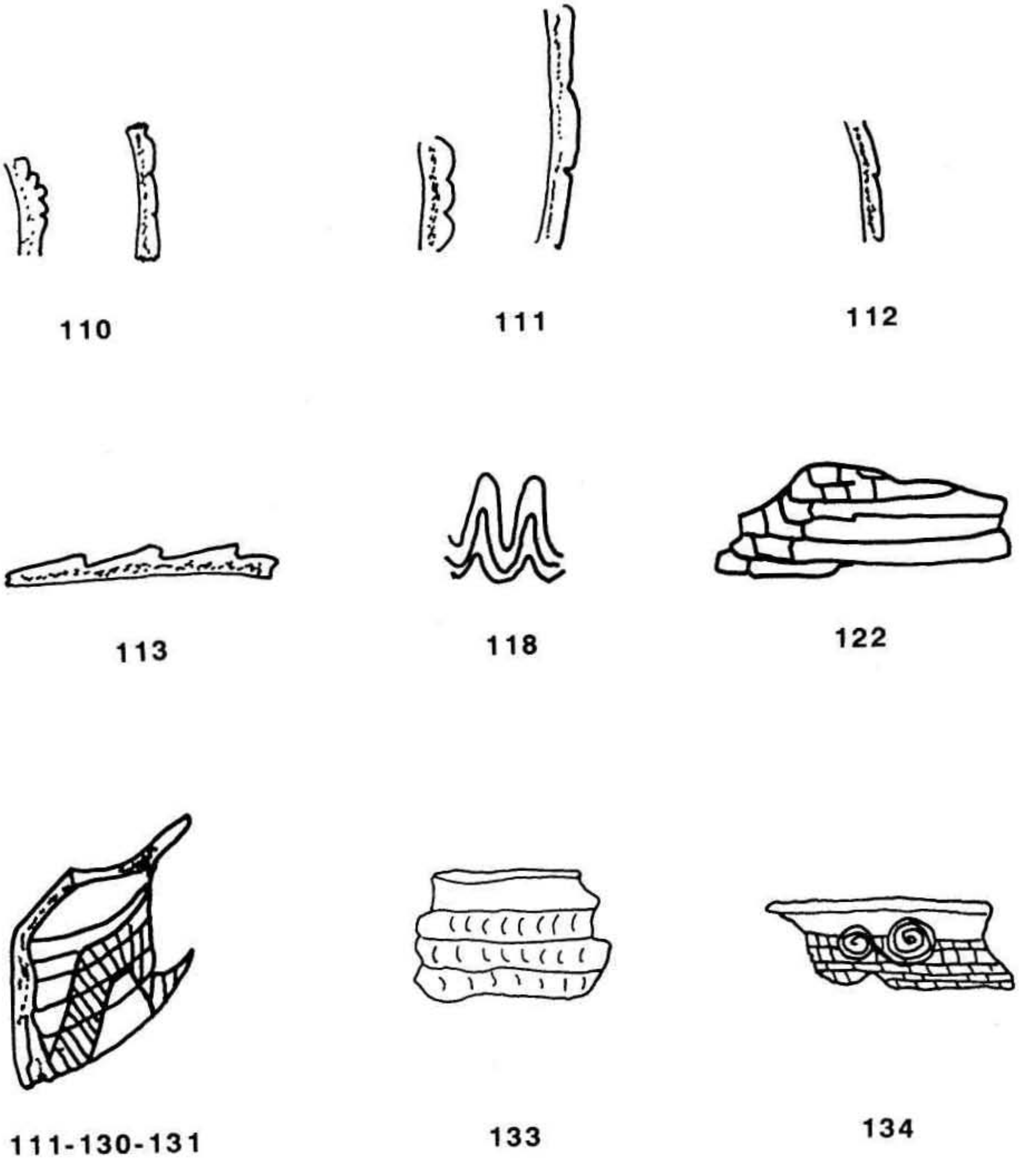
Design Elements for Variables 17, 18, and 19

Culinary Ware (Surface treatment [Table 2B.1] and culinary design styles [Figure 2B.2])

100, 101	Plainware, unpolished and polished—plain brown or grayware sherds. Polished specimens were distinguished by visible polishing strokes and exhibited a low to high polish.
103	Banded, undifferentiated—Neck and general body banded or clapboard specimens with less than three bands present.
110,111	Neckbanded, narrow (2-5 mm) and wide (>5 mm)—Neckbands without overlapping coils. Band junctures are not tooled but are natural junctures, perpendicular to the wall of the vessel. Wide neckbanded specimens exhibit fillets greater than 5 mm wide.
112, 113	Clapboard, narrow (2-5 mm) and wide (> 5 mm)—Neckbands with overlapping coils. Band junctures display a shingle-like arrangement in cross-section. Wide neck clapboard specimens have fillets greater than 5 mm wide.
114, 115	Tusayan Style Indented Corrugated, narrow (2-5 mm) and wide (>5 mm)—Corrugated with distinct pinched indentations. Wide corrugated exhibits a coil width larger than 5 mm. Corrugation width may or may not be equal to coil widths.
116	Moenkopi Style Corrugated—Corrugations are smeared or extremely flattened. This code is mostly used as modifier over a wide or narrow Tusayan pattern.
117	Indented Corrugated, undifferentiated—Rim specimens with three or less distinct corrugations.
118	Festoon Indented Corrugated—Coils or bands displaying an accentuated wave-like pattern.
120	Indented Corrugated, oblique or diagonal ridged—Also usually used as a modifier with a Tusayan style. This pattern was achieved by oblique alignment, diagonal to the vessels vertical of each indentation. Occasionally tooling or actual oblique ridging achieved this pattern but most frequently this was achieved by alignments of corrugations. Neither varieties nor direction of ridging was specifically coded but those patterns not identified in conjunction with a Tusayan style are most often a pattern in themselves.
121, 122	Corrugated Patterned, narrow (2-5 mm) and wide (>5 mm)—Alternating banded or clapboard bands with Tusayan style indentations. These designs often covered the entire jar and were not restricted to the neck. Large panels of corrugations

Table 2B.1. *Surface treatment labels and codes, in the order shown in type definition tables, undecorated wares only.*

Code	Old Label	Table Label	Total
100	Unpolished Plainware	Unpolished Plain	1,611
101	Polished Plainware	Polished Plain	614
103	Undifferentiated Banded	Undifferentiated Neckbanding	230
110	Narrow Neckbanded	Narrow Neckbanding 2-5 mm	94
111	Wide Neckbanded	Wide Neckbanding > 5 mm	115
112	Narrow Clapboard	Narrow Clapboard 2-5 mm	344
113	Wide Clapboard	Wide Clapboard > 5 mm	385
114	2-5 mm coil Corrugated Tusayan	Narrow Corrugated 2-5 mm	1,327
115	> 5 mm coil Corrugated Tusayan	Wide Corrugated > 5 mm	302
116	Flattened Corrugated Moenkopi	Flattened Corrugations	83
117	Undifferentiated Corrugated	Undifferentiated Corrugated	454
118	Festoon Indented Corrugated	Corrugated, festoon	86
120	Oblique Indented Corrugated	Corrugated, oblique	131
121	2-5 mm Patterned Corrugated	Patterned, narrow 2-5 mm	222
122	> 5 mm Patterned Corrugated	Patterned, wide > 5 mm	48
123	Unknown Corrugated Style	Corrugated, unknown	64
124	Mummy Lake Style	Mummy Lake Style	382
130	Incised across Coils	Incised across Coils	48
131	Incised between Coils	Incised between Coils	14
132	Punctate	Punctate	19
133	Fingernail Punctate	Fingernail Punctate	51
134	Applique Scrolls	Applique Scrolls	3
135	Basketry Impressions	Basketry Impressions	
	Total		6,627



110

111

112

113

118

122

111-130-131

133

134

Figure 2B.2. Culinary design styles identified by code value.

horizontally subdivided into two or more groups by a few (2-4) vessel encircling bands or clapboards were recorded as one style or another of Tusayan corrugation. Any design or motif patterning evident between the two areas was not recorded. Band and corrugation width consistently covaried with those wider than 5 mm designated as the wide variety.

123 Corrugated, unknown style—Rim fillets with no or only fragments of the first row of corrugations attached. Differentiation between these and undifferentiated banded rims is subjectively based on uprightness of the rim fillet, fillet width, scar patterning of the decorative coil attachments, and the context of the associated culinary.

124 Mummy Lake Style—A plain gray culinary ware distinguished from Lino Gray by finer tempering material, a flared rim, and associated ceramics.

130 Incised across coils—Incisions across the vertical axis of either plainware, corrugated, or banded pottery. Motifs formed by combinations were not recorded.

131 Incised between coils—Incisions or intentional horizontal highlighting of boundaries or junctures between corrugated or banded coils. Horizontal incisions on plainware sherds. Orientation of vessel is defined by an assessment of specimen curvature, visible coil orientations in cross-sections, and of surface finishing marks.

132 Punctate—Most often used as a modifier. Punctate decoration refers to any decorative perforation that does not completely pierce the vessel wall. The presence of multiple perforations or perforations forming a motif were not specifically recorded.

133 Fingernail Punctate—Semi-lunate punctures assumed to be made with the fingernail. Neither direction nor motif were recorded.

134 Applique Scrolls—Small, apparently as functional ridges and coils of clay, most often as opposed scrolls applied to the exterior of the vessel. Located at or just below the juncture of the rim fillet and the body.

135 Basketry impressions of any type or extent (invariably) on the vessel's exterior.

Painted Motifs (Table 2B.2; Figure 2B.3)

001 Isolated Single Elements—Multiple, repeated single item elements without elaborating ticks or lines.

Table 2B.2. Motif labels and codes, in the order shown in type definition tables.

Code	Old Label	Table Label	Total
1	ZZZ or WWW	Isolated single elements	22
2	Hooks, Flags	Hooks, Flags	209
3	Framed Line Elements	Nested isolates	67
4	Geometrics ± Interior	Unnested isolates	10
5	Stars, Suns	Stars, Suns	10
6	Overlapping Steps	Overlapping Steps	2
7	Zigzags; Non-overlapped	Non-overlapping steps	33
10	Parallel Lines	Parallel Lines	1,470
11	Cribbed Parallel Lines	Cribbed Parallel Lines	110
12	McElmo-Mesa Verde Banded Framers	Banded Framers	31
13	Parallel Lines Pendant from the Rim	Pendant Parallel Lines	458
14	Parallel Framing of Non-ticked Solids	Framers with unticked solids	299
15	Parallel Lines with Dotted Solids	Framers with ticked solids	244
16	> 3 mm Spaced Irregular wide lines	Irregular wide lines	40
17	Non Dot Ticking	Ticking	156
18	Solid Corner Triangles	Corner triangles	188
20	Scrolls	Scrolls	752
21	Framed Slashes	Framed Slashes	4
22	Framed Dots or Dots in Isolation	Dots	144
23	Framed Zs	Other Framed isolates	23
24	Exterior Framing Dots	Framing Dots	30
25	Framed Rows of Dots	Linear Dots	5
26	0-2 mm Dotted Lines, Barbed Wire	Dotted Lines	454
27	> 5 mm Scalloped Lines	Thick Wavy Lines	54
29	Parallelograms	Parallelograms	16
30	Dots Enclosed in Parallelograms	Dots in Parallelograms	2
31	Dotted Checkerboard	Dotted Checkerboard	8
32	Checkerboard	Checkerboard	452
33	Solids with Eyes	Eyed Solids	67
34	Sawteeth	Sawteeth	555
35	Barbs in Flagstaff Style	Barbs	336
36	Elongated Scalloped Triangles	Elongated Scalloped Triangles	53
37	> 5 mm Straight Lines	Wide Sosi Style	440
85	2-5 mm Straight Geometric Lines	Narrow Sosi style	228
38	> 2 mm Dotted Lines	Heavy Dotted Lines	43
39	Heavy Curvilinear Sosi Lines	Heavy Curvilinear Lines	130
86	2-5 mm Straight Sosi Geometric Lines	Narrow curvilinear	44

Table 2B.2. (continued)

Code	Old Label	Table Label	Total
40	Solid Elements in Band Design	Solid Band Design	1,610
41	040 with Hachure Elements	Hatched Band Design	63
42	Massive Large Solid Triangles	Isolated Triangles	42
43	Undifferentiated Solids	General Solids	1,532
44	Bold Bisecting Lines	Bold Bisecting Lines	7
50	Hachure A-1	Hachure A-1	484
52	Hachure A-2	Hachure A-2	59
60	Hachure A-3	Hachure A-3	90
53	Hachure B-1	Hachure B-1	479
54	Hachure B-2	Hachure B-2	20
55	Hachure B-3	Hachure B-3	286
56	Hachure B-4	Hachure B-4	485
58	Hachure B-5	Hachure B-5	8
59	Hachure B-6	Hachure B-6	150
61	Cross-hatched B-7	Hachure B-7	48
51	Hachure B-C	Hachure B-C	198
57	Hachure C	Hachure C	109
62	Counterchange	Counterchange	40
63	Hatched Checkerboard	Hatched Checkerboard	93
64	Heavy Line Gallup Squiggle	Heavy Gallup Squiggle	40
65	Hatched Pendant Triangles	Hatched Pendants	18
70	Multiple Squiggle Lines	Squiggle Lines	446
71	Interlocked Frets or Steps	Interlocked Frets	24
72	Anthro or Zoomorphic	Anthro/Zoomorphs	30
73	Solid Ticked Triangles	Solid Ticked Triangles	758
80	Isolated Interior Rim Motif	Painted Motif on Rim Interior	1
81	Painted Design on Exterior	Exterior Bowl Motif	167
82	Exterior Jar Rim Design	Jar Neck Motif	321
83	Polychrome with White Exterior Design	White Exterior Design	15
84	Polychrome with Unslipped Motif Area	Unslipped Motif Area Polychrome	5
87	Interlocking Ticking from Solid Elements	Interlocking Ticking	161
995	Other Solid	Others, Solid	37
996	Other Hatched	Others, Hatched	375

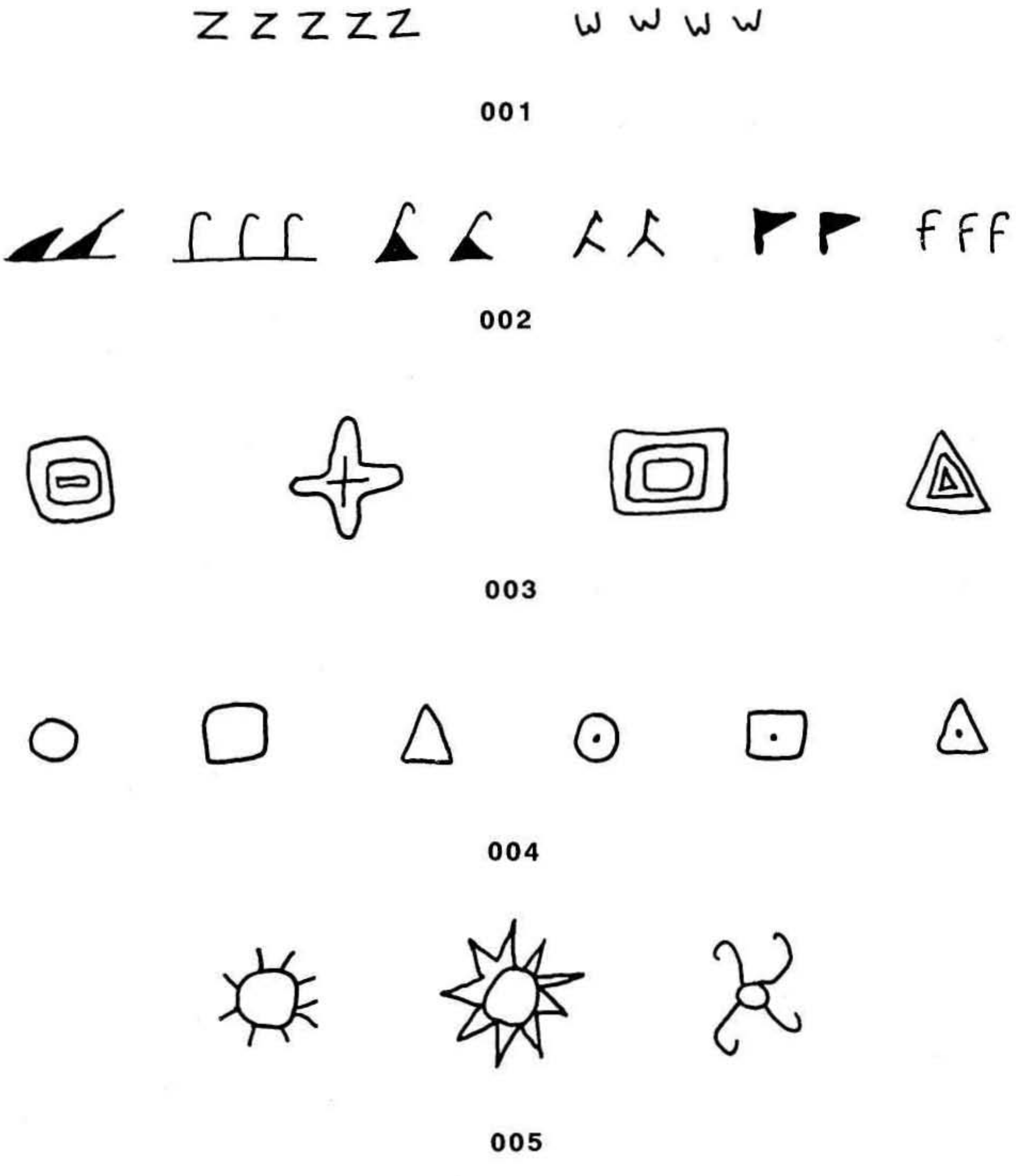
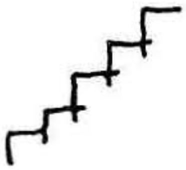


Figure 2B.3. Painted motifs identified by code value.



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007

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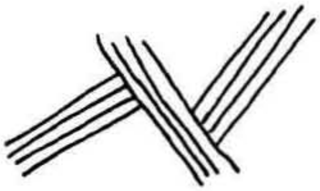

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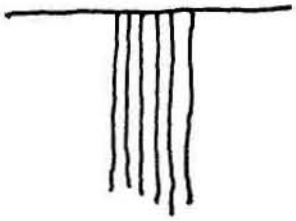

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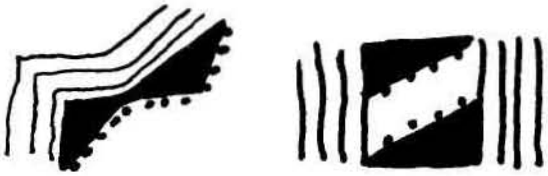

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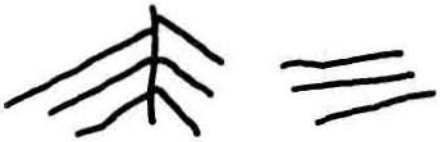

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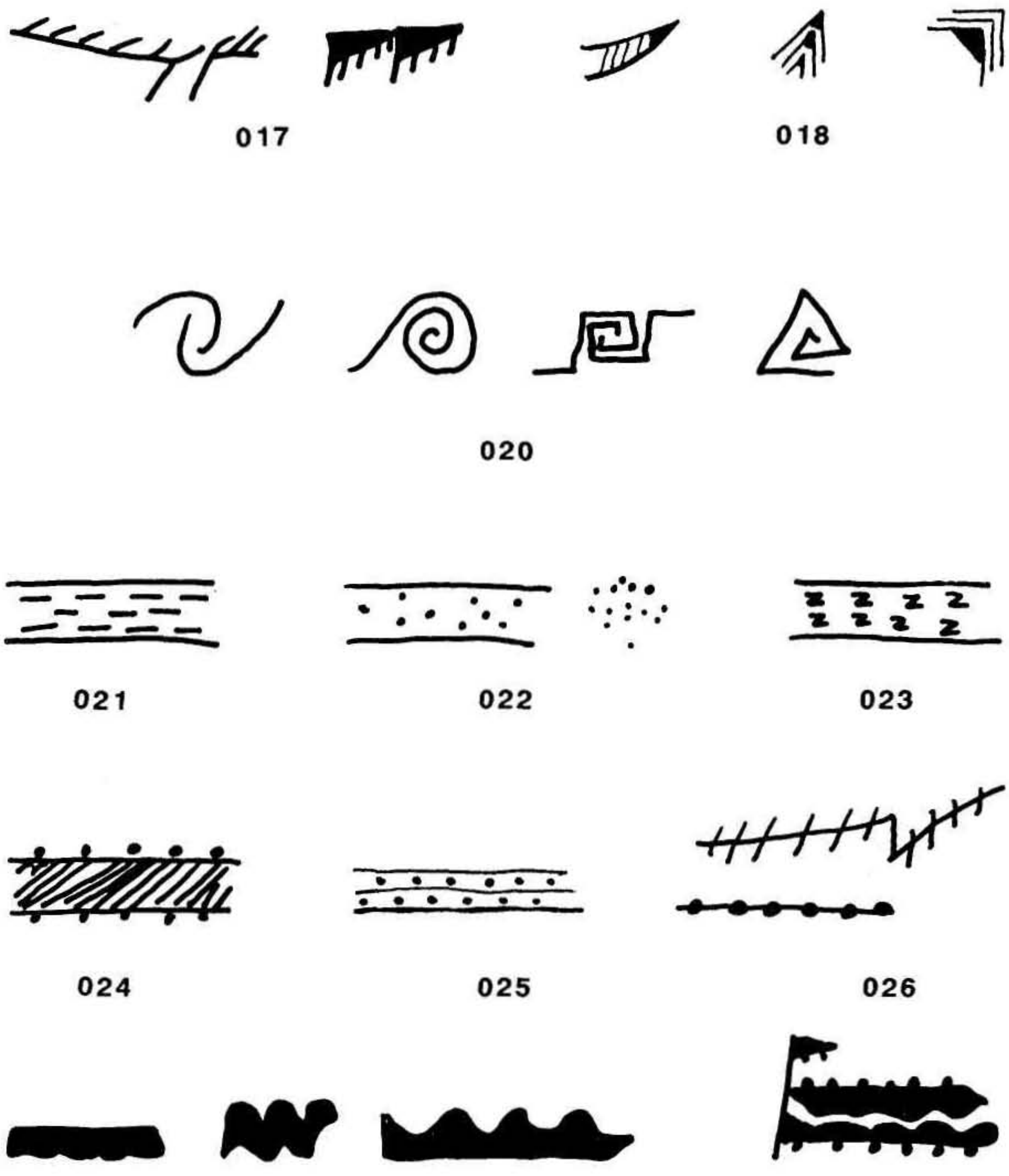

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027-024

Figure 2B.3. (continued)

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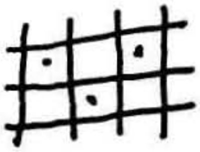

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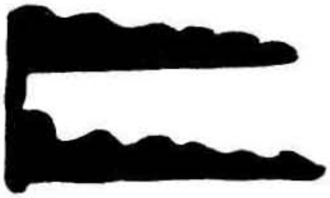

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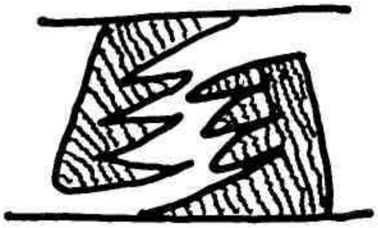
Figure 2B.3. (continued)

040



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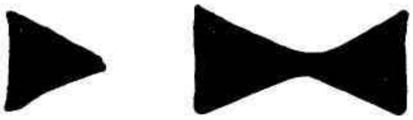

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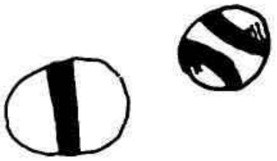
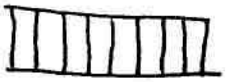


044

050

051



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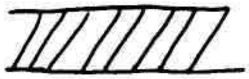

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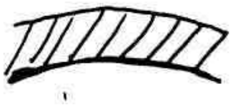

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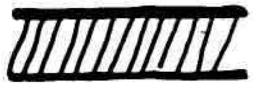

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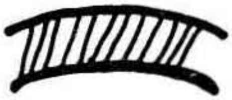

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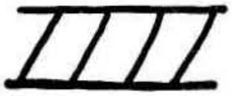

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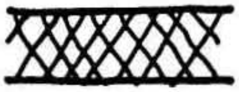

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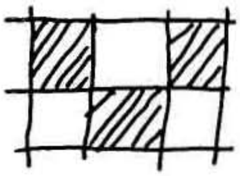

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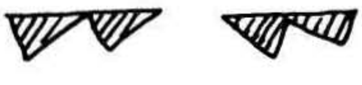

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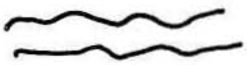

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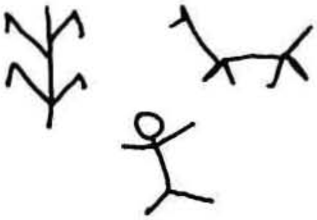

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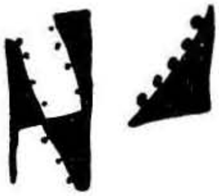

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996

Figure 2B.3. (continued)

002	Isolated or Continuous Elements with hooks or flags—Small elements (no larger than 5 mm circumference) usually linearly interconnected which are marked by proximally oriented small hooks or extended curved lines. Occasionally such elements are arranged in small rosettes either isolated or incorporated into a larger design. Small flags also occur in this group.
003	Nested Isolates—An enclosed line motif with smaller, enframed replicas of itself on the interior.
004	Unnested Isolates—Simple line elements of geometric forms with or without dots in the center. Interior dots are rare.
005	Stars or Suns—Circular centered motifs with radiating appendages that appear to be "suns" or "stars."
006	Overlapping Steps—Linear motifs with a step-like appearance. The intersection of line junctures do not exactly meet but overlap the juncture by at least 0.5 mm.
007	Nonoverlapping Steps—Like the preceding motif but line junctures do not exceed their intersections by more than 0.5 mm.
010	Parallel Lines—Two or more straight parallel lines no wider than 1 mm each and spaced no further than 3 mm apart. Straight refers to the characteristic of the line execution, lines may be oriented curvilinearly, rectilinearly, or with an unbroken "stepped" component; multiplicity of the lines distinguishes this from designs 006 and 007.
011	Cribbed Parallel Lines—Multiple straight parallel lines that abut or terminate against another set of juxtaposed parallel lines. Often these elements are used as angled panel subdividers in band designs.
012	Banded Framers—Parallel lines encompassing a band design. Often either the exterior or interior line will be thicker than its counterparts and evidence of a band design will frequently be found sandwiched between two framers or between a single bottom framer and a rim. This particular motif is often found after A.D. 1100 on McElmo, Mesa Verde and temporally affiliated types.
013	Pendant Parallel Lines—Multiple lines either pendant from rim or as panel dividers in band designs.
014	Parallel Framers with Unticked Solids—Multiple, stepped or unstepped continuous thin (less than 3 mm) parallel lines adjacent to and framing solid elements without dotted or scalloped "ticked" edges.
015	Parallel Framers with Ticked Solids—Multiple, stepped or unstepped continuous thin (less than 3 mm) parallel lines

	adjacent to and framing solid elements with dotted or scalloped "ticked" edges.
016	Irregular Wide Lines—Widely spaced (greater than 3 mm) continuous and noncontinuous thick (greater than 3 mm less than 5 mm) parallel lines that are irregular in execution.
017	Ticking—Short thin lines applied to solid elements or lines, not dots. Mostly used as a modifier and distinguished from hooks and flag elements.
018	Corner Triangles—Acute corner angles of nested chevrons and hatched motifs that are painted with a small, solid filler. Used as a modifier.
020	Scrolls—Interlocked or individual curvilinear or rectilinear motifs that are self-involuted or reflectively opposed units.
021	Framed Slashes—Multiple, short lines or dashes within framing lines.
022	Dots—Multiple dots either within framing lines or free-form on the specimen.
023	Other Framed Isolates—Other multiple framed unit elements such as zs or ms.
024	Framing Dots—Dots appended to the exterior borders of framing lines regardless of framed pattern. Used as a modifier.
025	Linear Dots—Dots linearly arranged between parallel lines. Most commonly found on late carbon painted specimens.
026	Dotted Lines—Single or multiple line with dots or slashes applied to, or appended from, the line center.
027	Wavy Lines—Thick (greater than 5 mm) lines that are scalloped or wavy in appearance. One or both sides may be wavy or scalloped.
029	Parallelograms—A series of contiguous solid angled right triangles that produce a negative design parallelogram affect from unpainted interior areas.
030	Dots in Parallelograms—As above (029) but with dots in the unpainted "parallelogram" portion.
031	Dotted Checkerboard—Gridded parallel lines without solid checkerboard fillers. Single or multiple dots are staggered or fill entire gridded field.

032	Checkerboard—Gridded parallel line without filler dots or with alternating solid filled grids. Grid form may be cubical, rectangular, parallelogram, or triangular.
033	Eyed Solids—Solid motifs such as triangles or rectangles with centered, circular, unpainted center sections. Center dots in the unpainted areas may or may not occur.
034	Sawteeth—Continuous contiguous, opposed or alternating solid isosceles triangles.
035	Flagstaff Style Barbs—Angular or barbed-like right triangular solid motifs.
036	Judd's Solids—Large solid triangles with a thick scalloped edge along the hypotenuse edge.
037	Wide Sosi Style—Thick (greater than 5 mm) parallel and/or acutely angled and nested lines.
085	Narrow Sosi Style—Like above (037), but with narrow (2-5 mm) line work.
038	Heavy Dotted Lines—Rectilinear or curvilinear lines greater than 2 mm with pendant dots.
039	Heavy Curvilinear Lines—Multiple or single curvilinear lines wider than 5 mm.
086	Narrow Curvilinear Lines—As above (039) but 2-5 mm wide.
040	Solid Band Design—Band designs in which the principal components are solid elements such as triangles. Internal scrolls, parallel vertical panel dividers, or ticked line elements are recorded as second design features.
041	Banded Hatched Motifs—Hatched motifs of unspecified nature within framing lines. In conjunction with this designation the nature of hachure may be specified as a secondary design element.
042	Isolated Triangles—Plain large, unticked triangles isolated from other elements. These often occur as bottom-oriented filler motifs in later pottery types.
043	General Solids—Undifferentiated and unintelligible solid painted areas occurring on "unidentified" specimens or fragmentary unspecifiable elements in conjunction with other motifs, usually hachures.
044	Bold Bisecting Lines—Solid bold (greater than or equal to 1.5 cm) wide lines bisecting or transecting the design area; usually on early specimens such as Abajo Red-on-orange.

Hachure Motifs:

050	Red Mesa A—Framing lines same value as the squiggled hachure. Hachure lines are 1-2 mm thick and spaced 2 mm or more apart. Rectilinear or more frequently curvilinear execution.
051	Gallup-Chaco A—Framing lines are same value as squiggled hachure. Hachure width is much finer, usually less than 1 mm. Spacing of hachure is generally 1 mm or less. Rectilinear execution.
052	Red Mesa B—Framing lines are the same value as the straight line parallel hachure. Hachure lines are about 1 mm thick and spaced between 1 and 2 mm apart. Rectilinear or curvilinear executions.
053	Gallup A—Framing lines are the same value as the straight line slanted hachure. Hachure lines are about 1 mm thick and are spaced 1-2 mm apart. Rectilinear execution.
054	Gallup B—As Gallup A (053) but executed in curvilinear fashion.
055	Gallup C—Framing lines are heavier than slanted hachure. Hachure lines approximately 1 mm wide and spaced 2 mm or more apart. Rectilinear execution.
056	Gallup-Chaco B—Framing lines are heavier than slanted hachure. Hachure lines are less than 1 mm wide and spaced 1-2 mm apart. Rectilinear execution.
057	Chaco—Framing lines heavier than slanted hachure. Hachure lines less than 0.7 mm wide and spaced less than 1 mm apart. Rectilinear execution.
058	Gallup D—Framers heavier than patterned hachure. Hachure is patterned into interlocked, contiguous triangular motifs. Any hachure width and spacing was included but was most commonly within the range of types 056-057 above.
059	Gallup E—Like Gallup C (055) above but in curvilinear execution.
060	Red Mesa-Gallup—Framers and diagonal or parallel hachure of equal thickness. Hachure and framers may be as thin as 1 mm but most often are heavier than 2 mm and spaced more than 2 mm apart. Wide spacing and heavy line work were critical determinants of this variety of hachure.
061	Gallup F—Framers most often heavier than crosshatched diagonal hachure. Spacing and line width were not specified criteria in this hachure variety although coarseness and spacing did not exceed that defined for the 055 variety.

062	Counterchange—Mirrored hatched and solid elements. Hachure style and values are not specified nor was the exact nature of the mirrored motifs.
063	Hatched checkerboard—Gridded line work with alternating panels hatched in an unspecified manner (vertical or diagonal with any spacing). Values of hachure versus framer grids were also unspecified.
064	Heavy Line Gallup Squiggle—Framing lines of even value with squiggle line hachure, about 2 mm thick. Spacing generally 1-2 mm or less. Rectilinear execution most frequent but not specified.
065	Hatched Pendants—Hatched triangular forms pendant or alternating from lines or rims. Width and spacing of framing and hachure lines not specified, but straight.
070	Squiggle Lines—Multiple unbanded, parallel squiggled lines usually no thicker than 2 mm.
071	Interlocked Frets—Interlocked step-like motifs similar to counterchange (062) but both elements are painted solid. Occurrence is most frequent on later (PII-III) carbon painted types.
072	Anthropomorphic or Zoomorphic—Isolated or pendant anthropomorphic or zoomorphic figures. Not painted effigy forms.
073	Solid Ticked Triangles—Fragments or isolated structurally unrelated occurrences of ticked solid triangles. Vertical bands of ticked solid triangles also included.
080	Culinary Motif—Isolated painted motifs on the interior neck of culinary vessels. Motif forms not specified.
081	Exterior Bowl Designs—Exterior motifs on black-on-white bowls. Either unit or band designs.
082	Jar Neck Motif—Unit motifs located on the exterior of whiteware jar necks. The design or motif is not specified, but does not include panel or band designs common on pitchers or necked vessels with complete free formed designs beyond the motif level.
083	White Exterior Designs—White Mountain Polychromes with white exterior paint (bowls). Design, width, and nature of design not specified.
084	Unslipped Motif Areas—Tusayan polychromes which incorporated unslipped areas as part of the design effect. Not specified as to form width or surface.

087	Interlocking Ticking—Opposed ticked lines extending from solid elements, usually a stepped or terraced motif often in conjunction with interlocking scrolls.
995	Others, solid—Solid pendant motifs from interior bowl rims (exterior pitcher rims) and isolated terraced elements with interlocked ticked lines extending from them. Often these motifs act as fillers independent from an over-all hatched decoration, particularly on bowls.
996	Others, hatched—A fragmentary, indeterminate hatched motif.

20	Rim length in mm. (measured along top edge—orifice rim only, not gourd handle rims)	46-48
21	Estimated rim diameter (use wire press form against rim interior then match to concentric circles)	50-52
22	Rim form in degrees of arc/flare (culinary only—Windham method)	53-54
23	Rim fillet width in mm—culinary only	55-56
24	Orifice to rim differential in mm—culinary only	57-58
25	Handle type (Figure 2B.4)	59-60

01	Solid coil
02	Multiple solid coils
03	Solid flattened coil (strap)
04	Tubular
05	Tubular with perforations
06	Trough (e.g., gourd ladle handle)
07	Extended lip (e.g., on culinary)
08	Nubbin
09	Dual nubbins
10	Button
11	Cupped/indented (e.g., in painted ollas)
12	Strap lug
13	Solid tabular lugs
14	Cupule lug
15	Curved or sagging nubbins
16	Perforated nubbin-lug
17	Bifurcated extended lip
18	Multiple solid coil strap lug
19	Bifurcated solid tabular lugs
20	Effigy handles
21	Vertical tabular fillets
90	Worked sherds
99	Unknown

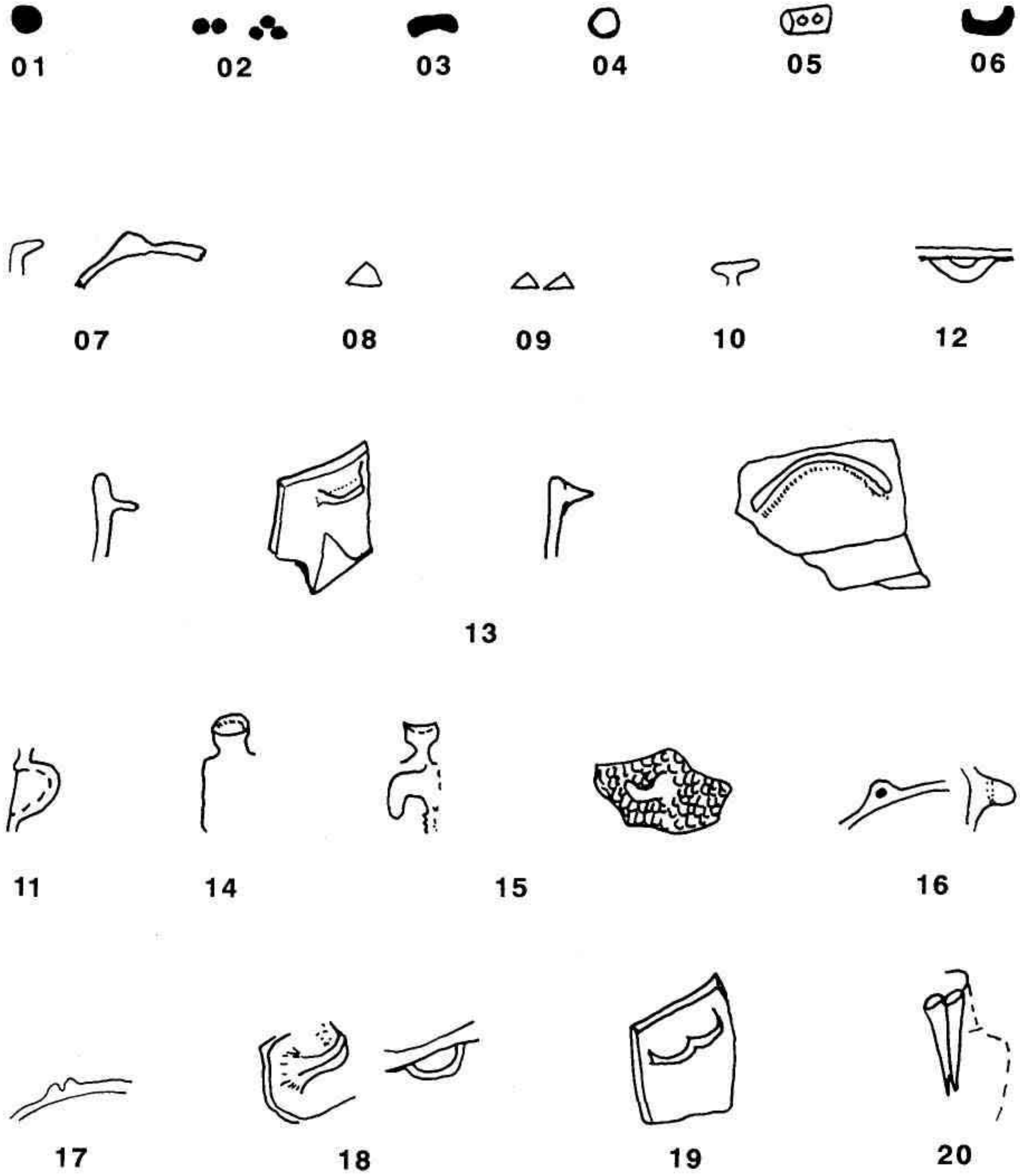


Figure 2B.4. Handle types identified by code value.

26	Sooting		61
	1	Present (encrusted carbon)—culinary only	
	2	Absent	
	3	Blackened (e.g., exterior or rims of whiteware bowls)	
	4	Red pigment	
	5	Mineral encrustation (assumed H20 deposits)	
27	Temper #1		62-65
	Temper #2		66-67
28	Helene Warren's ceramic type code		68-70
29	FS number		74-77
30	Sherd number (in red felt tip) numbered consecutively within FS		78-80

Temper Variables, Updated System III

Variable No.			Column
27	Origin-formation-material		62-64
	0	All sherd--virtually never used	
	200	Sandstone of unspecified formation	
	230	Morrison formation with pink chalcedonic cement } Prewitt?	
	231	Morrison formation with white chalcedonic cement } "	
	255	"Buffalo Springs" sandstone—with rounded iron fragments	
	292	Sandstone with magnetitic cement—unknown formation	
	300	Unidentified crushed igneous rock	
	301	San Juan crushed igneous rock with hornblende	
	302	San Juan crushed igneous rock lacking hornblende	
	341	Hornblende andesite	
	373	Glassy andesite (?) with gray matrix	
	374	Andesite vitrophyre	
	381	Trachyte or sanidine basalt	
	700	Sandstone—unidentified igneous mix	
	701	Sandstone—301 mix	
	702	Sandstone—302 mix	
	741	Sandstone—341 mix	
	773	Sandstone—373 mix	
	774	Sandstone—374 mix	
	781	Sandstone—381 mix	
	800s	The same as 700s but with more igneous material than sandstone plus:	
	882	Sand-381-301/302 mix	
	900	Not observable (insufficient break available)	
28	Grain size—where sand of any sort is present this column refers to sand grain size; refers to temper particles in the absence of sand		65
	1	Fine or very fine—less than 0.25 mm	
	3	Medium range—0.25-0.75 mm	
	5	Coarse—0.75-1.25 mm	
	6	Very coarse—over 1.25 mm	
33	Density estimate, follows Bennett (1974:105) but refers to all temper particles. Grids expanded to match predominant temper size		70
	1	1-2%	
	2	5%	
	3	10%	
	4	20%	
	5	30%	
	6	40%+	

34 Temper/paste types 71

0	Does not fit a type
1	Black paste with white sherd temper
2	Gray paste with black sherd temper
3	Mixed black and white sherd temper, gray paste
4	Little Colorado—abundant white sherd temper, gray brown paste
5	"Chuska" gray paste
6	White sherd in gray paste
7	Tan paste
8	Black paste, lacking white sherd temper
9	White paste

35 Sherd temper quantity relative to other type 72

0	No sherd temper
1	0-50% of temper is sherd
2	50-99% of temper is sherd
3	All temper is sherd—used when non-sherd temper elements are extremely rare (ca. 1% or less)
9	Not observable (sherd worked, too small, etc.)

36 Vitrification 73

0	Absent
7	Sherd appears to be high-fired—some sheen, usually hard
8	Clearly vitrified—high sheen, alterations

Appendix 2C

Clay Sample Data

H. Wolcott Toll and Peter J. McKenna

The following clay sample data sets include 21 from several areas in Chaco Canyon (Figures 2C.1-2C.4), plus one from San Isidro and one from Albuquerque that were collected for comparative purposes.

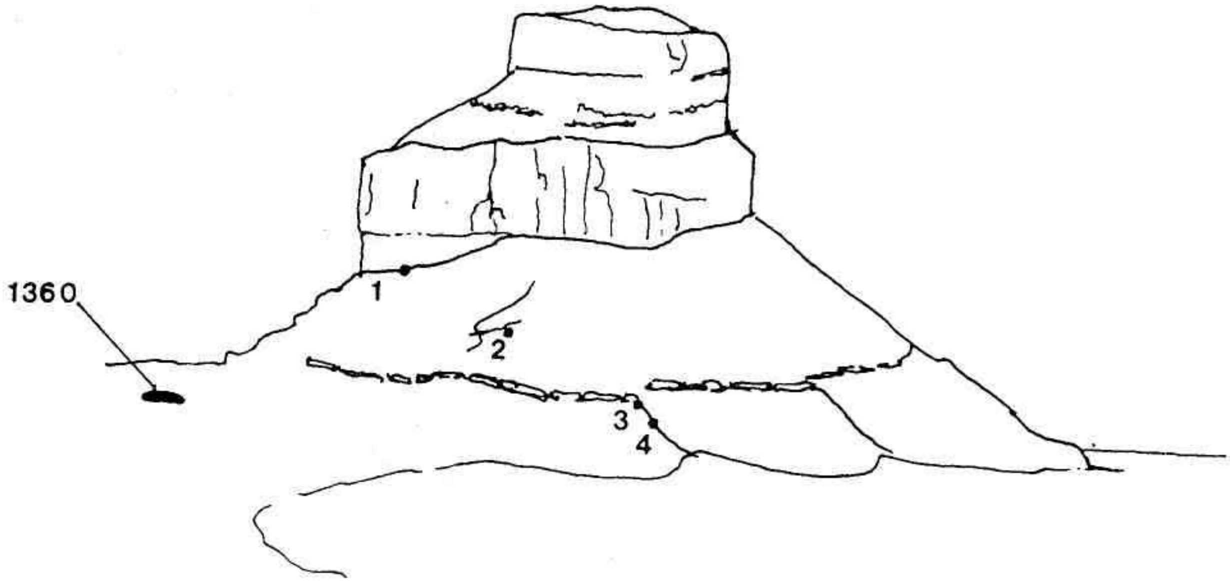


Figure 2C.1. Location of clay samples from Fajada Butte.

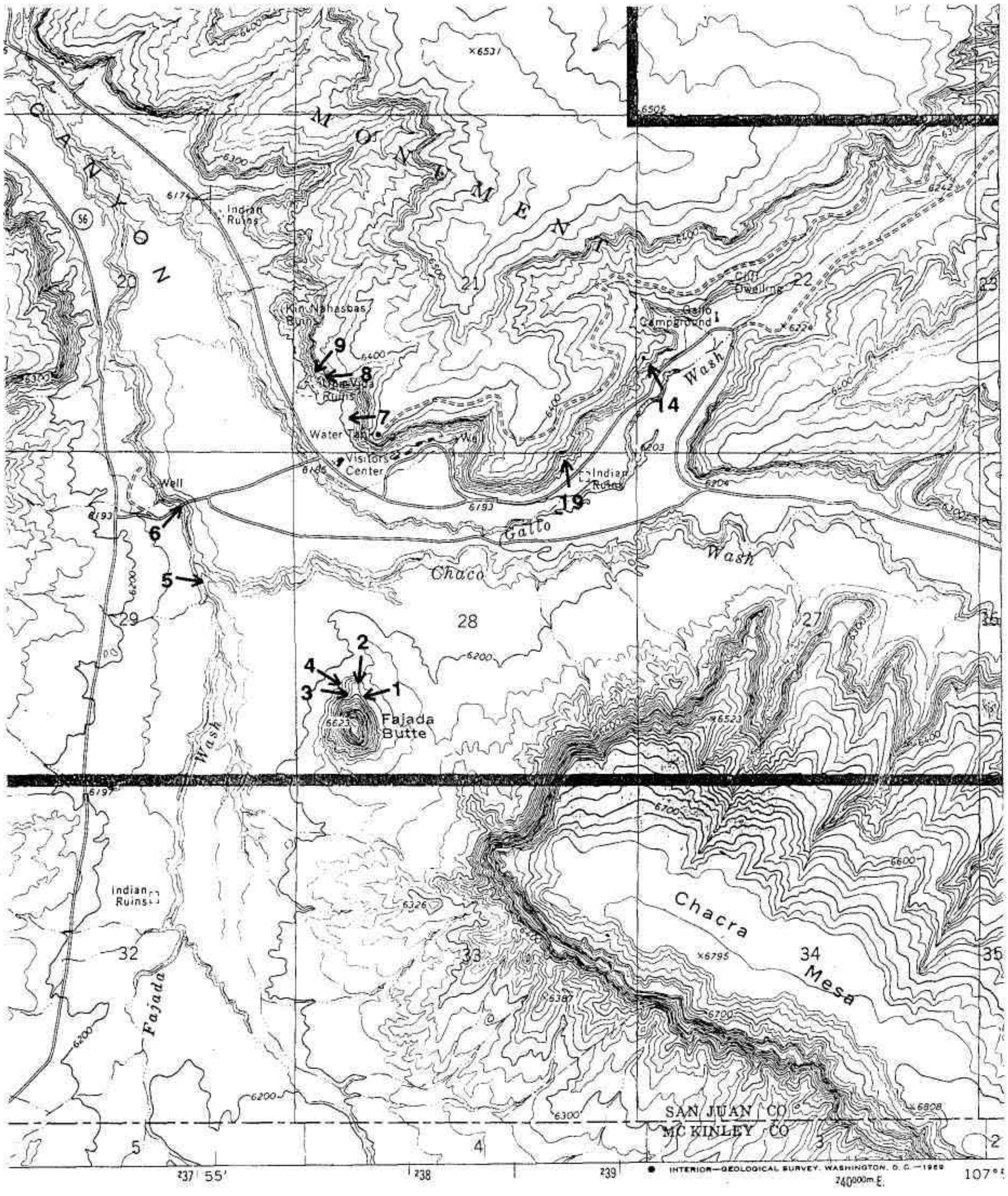


Figure 2C.2. Clay sample locations, Pueblo Bonito Quad, T21N, R10W. Samples 1-9, 14-15, 19.

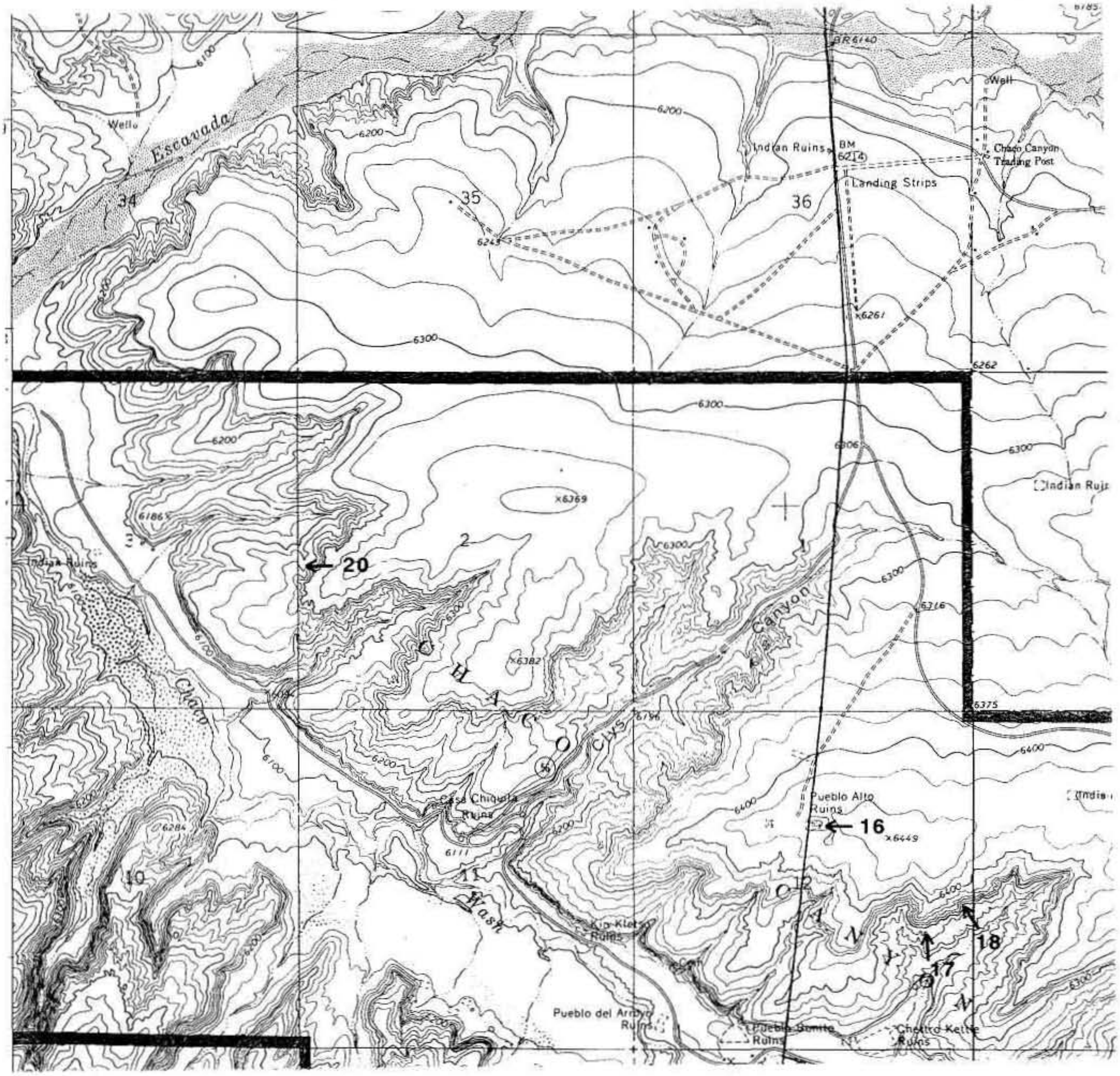


Figure 2C.3. Clay sample locations, Pueblo Bonito Quad, T21N, R10W. Samples 16-18 (Cliff House Formation and Lewis Shale), 20.

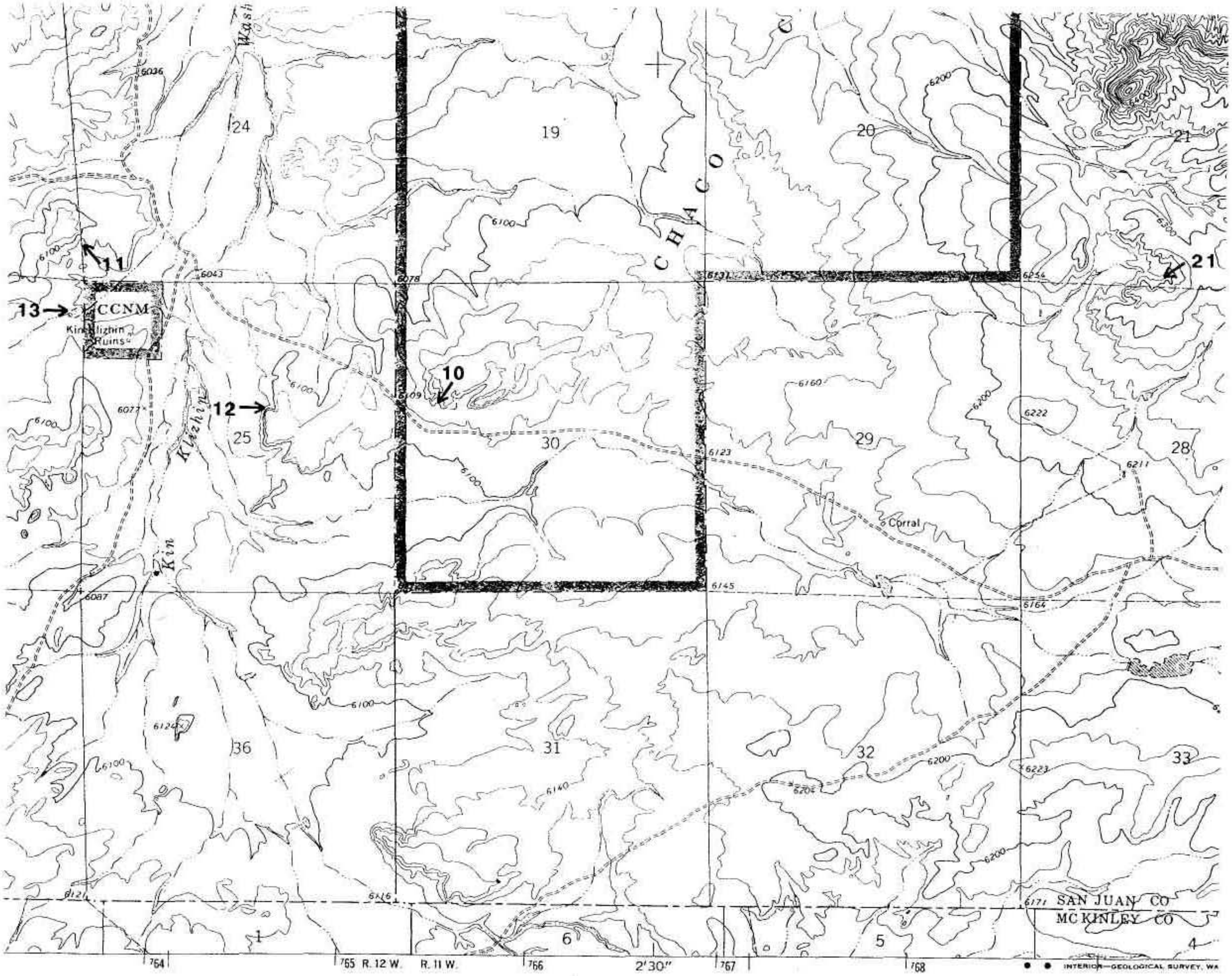


Figure 2C.4. Clay sample locations, Kin Klizhin Quad, T21N, R11W and R12W. Samples 10-13, 21.

CLAY SAMPLE DATA: SAMPLE NO. 1

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of SW 1/4 Section 28 T21N, R10W, 6,300'
Description	From the north side of Fajada Butte, at the base of the largest cliff; above and slightly east of the prominence that runs by 29SJ 1360.

DEPOSIT

Formation	Top of Menefee (base of Cliff House? Formation)
Description	1-1.5 m of very hard, laminar dark gray clay. Selenite and coal present in the immediate adjacent deposits.
Date/by	9/18/81 by P. J. McKenna and H. Wolcott Toll

TREATMENT

Soaking	Several lumps placed in tap water about 2:30 p.m. on 10/12/81. On 10/13 at 1:30 p.m., clay is mostly dissolved, but small plates of undissolved clay remain; these can be broken down with finger tips; no grinding. On 10/14 at 8:30 a.m., some platy pieces remain.
Settling	On 10/14 at 8:30 a.m., placed in 5 cm column after thorough stirring; plates do not pour off. On 10/15 at 9:00 a.m., 26 mm yellowish but transparent water with cloudy scum at surface; 24 mm homogeneous dark brown-gray clay; ca 1 mm black specks with dark brown-gray clay. On 10/21 in the a.m., a second column was prepared starting with mixed, non-liquid clay in an effort to make it more likely that heavy portions would be included, then shaken into a liquid state; no discernible difference from the first column.
Wet color	2.5Y 4/2
Hydration	Left under standing water which was allowed to evaporate until 10/21 in the a.m. Placed under moist paper towels to bring to working consistency. After tiles formed, remainder of hydrated clay placed in plastic bag on 10/22 in the p.m.
Tile	2 tiles formed on 10/22 at 4:15 p.m.: No. 1a—10.57 x 4.81 cm. No. 1—10.08 x 5.00 cm.
Workability	This clay is very smooth and feels "nice"—a fillet can be formed and made into a ring, but I found that some addition of water was necessary to counteract cracking; this is probably a problem of water content rather than clay workability.
Polishing	Polished with pebble when leather hard on 10/23 at 1:00 p.m.; No. 1a is ca 3x3 cm.
Drying	Dry by 10/27 (10/26), no cracks, both tiles have a peculiar dark rind around the upper edge. Tiles were turned during drying which may have affected their color.
Dry Color	10YR 6/2 polished; 10YR 5/2; rind 10YR 4/2
Shrinkage	Dry size: No. 1a—9.43 x 4.35 cm; 10.79 x 9.56%. No. 1—9.18 x 4.44; 8.93 x 11.2%. No. 1—high sheen, especially on top of tile; it retained shape but shrank further. Top edge shows very fine bubbling all the way around.

FIRING

Temperature	No. 1a 910° C, ox. 1/26/82. No. 1 1250° C, ox. 5/18/82
Fired color	No. 1a 7.5YR 7/4; rind 7.5YR 8/2; polish ever so slightly darker 10YR 5/2
Fired size	No. 1a: 9.41 x 4.34 cm. No. 1: 8.48 x 4.18 cm; 7.62 x 5.86% further shrink
Fired properties	No. 1a fired beautifully, no cracks, distinct ring when tapped.

CLAY SAMPLE DATA: SAMPLE NO. 2

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of SW 1/4 Section 28 T21N, R10W, 6,620'
Description	North side of the base of Fajada Butte; where the promontory that runs by 29SJ 1360 joins the main talus from the butte; above the lowest small sandstone cliff; from the west side of the prominence, below a sandstone ledge. From near Sample No. 1, but down a section below the next sandstone layer.

DESCRIPTION

Formation	Menefee
Description	Somewhat lighter gray, especially where weathered. Contains coal specks.
Date/by	9/18/81 by H. Wolcott Toll and Peter J. McKenna

TREATMENT

Soaking	Several lumps placed in tap water about 2:30 p.m. 10/12/81. On 10/13 at 1:30 p.m., completely dissolved; very smooth to the touch. No grinding necessary.
Settling	On 10/13 at 1:30 p.m. placed in a 5 cm column after thorough mixing with water. On 10/14 at 1:30 p.m., 29 mm yellowish but transparent water; 20 mm gray clay; grades to slightly darker toward the bottom because of minute black specks that are absent in the ca. 6 mm at the top of the clay portion; 1 mm maximum of denser layer of minute black specks.
Wet color	10YR 6/2
Hydration	Standing water allowed to evaporate until the morning of 10/22 at which time the clay was quite stiff; placed under wet paper towels.
Tile	Two formed 8:00 a.m. on 10/23: No. 2a—9.87 x 5.18 cm. No. 2—10.25 x 5.01 cm.
Workability	At times during the soaking process, this clay had a somewhat sandy appearance, but this property is not evident to me when molding it; a coil can be formed without major cracking and the workability seems good.
Polishing	Polished 10/24 at 9:20 a.m. Slightly more than leather hard, still partly damp but dry around edges. Lightens rather than darkens surface. Black, damper side also polished; behaves more like others.
Drying	Apparently completely dry by 10/27 (10/26?). No cracks are present.
Dry color	10YR 7/2. Polished 10YR 6/2.
Shrinkage	Dry size: No. 2a—8.79 x 4.62 cm; 10.94 x 10.81%. No. 2—9.10 x 4.45 cm; 11.22 x 11.18%. No. 2 has high sheen but retained shape; no cracks or bubbling visible; further shrinkage.

FIRING

Temperature	No. 2a 910° C; 1/26/82, ox. No. 2 1250° C; 5/18/82, ox.
Fired color	No. 2a 10YR 8/4; polish very slightly darker; 2 10YR 6/3
Fired size	No. 2a—8.82 x 4.62 cm. No. 2—8.69 x 4.27 cm; 3.52 x 4.04%; further shrinkage.
Fired properties	No. 2a—excellent, crack free; rings when struck.

CLAY SAMPLE DATA: SAMPLE NO. 3

LOCATION

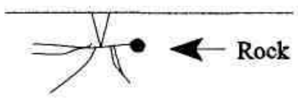
Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of SW 1/4 Section 28 T21N, R10W, 6240-6260'
Description	From the north side of Fajada Butte, on the west side of the prominence that runs by 29SJ 1360, below the bottom-most exposed sandstone layer. From within a well-entrenched drainage; the sample was taken from a small concavity from which clay may have been removed before, perhaps prehistorically. Two strata below No. 2, same stratum as No. 4.

DEPOSIT

Formation	Menefee
Description	The clay occurs as a hard, dark, gray deposit with fissures. The clay must be pried out of the deposit. It is, thus, similar to No. 1 and No. 9. Where exposed (see No. 4) it is lighter; the layer is extensive.
Date/by	9/18/81 by Peter J. McKenna and H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water at 1:00 p.m. on 10/23/81. Breakdown quite rapid; by 2:30 p.m. large lumps are gone; platy fragments are visible. Two rocks were present in the sample soaked, one ca. 2 cm in diameter; they are iron brown in color and exfoliate in sharp-edged pieces.
Settling	Mixed, stiff clay redissolved and shaken in water on 10/30 at 7:30 a.m. At 5:00 p.m. on 10/31, no surface film; 10 mm of transparent but deep reddish to brownish-yellow water—7.5YR-10YR 6/8-7/8—suggest sulphur; ca 0.2 mm of very, very fine light brown-yellow on the top of the sediment; 2 mm of lighter brown and finer than bulk; 32 mm of brown, homogeneous; no black specks; 3-5 mm same, but with obviously coarse particles leaving small interstices—these are plates of clay.
Wet color	10YR-2.5Y 4/2
Hydration	Water allowed to evaporate; gone by 10/30 at 7:30 a.m.; placed under damp towels. The towels take on a yellow stain when the absorbed water dries—variable but ca. 10YR 7/6-7/8.
Tile	Formed at 5:00 p.m. on 10/31: No. 3a—10.00 x 4.94 cm. No. 3—9.91 x 4.88 cm.
Workability	This clay seems exceptionally nice—a good workable consistency; will form coils and fillets—cracks form but are easily smoothed with a wet finger. Small rock fragments may occasionally be felt, and these drag on the surface when scraped.
Polishing	On 11/1 in the p.m., polished when slightly drier than leather hard, but does polish; some cracks are present in No. 3a, the polished tile.
Drying	Both tiles show a brownish stain, only on the top of each, which presumably dried more quickly. While No. 3 is crack free, No. 3a shows three areas of cracking. The most severe is on the bottom edge at the middle of the long dimension of the tile; a rock fragment protrudes here and undoubtedly contributed to the cracking. This is a set of hairline cracks 11 x 15 x 8 mm. The other two cracks are also on edges and are less developed.



Dry color	Unstained: 10YR 6/2. Stained: 10YR 4/3-4/4. Polished: 10YR 4/2.
Shrinkage	Dry size: No. 3a—8.90 x 4.36 cm; 11.00 x 11.74%. No. 3—8.87 x 4.49 cm; 10.49 x 7.99%.

FIRING

Temperature	No. 3a—910° C, ox., 1/26/82. No. 3—1250° C, ox., 5/18/82
Fired color	No. 3a—5YR 6/6, polished; 5/6-6/6, stain is no longer visible on fixed tile. No. 3—5YR 4/4 (bottom) lighter inside.
Fired size	No. 3a—8.79 x 4.33 cm. No. 3—9.08 x 4.50 cm x 4.7 cm thick. Mean: + 0.22 x +2.37 + ca. 470% expansion.
Fired properties	No. 3a—no further cracking developed, appears to have fixed well; rings. No. 3—dramatic change—bloated to 4.7 times original thickness; bubbling around upper edge; stretching and tearing marks on sides and tops; glassy spots in tear on top; dark sheen on top.

CLAY SAMPLE DATA: SAMPLE NO. 4

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of SW 1/4 Section 28 T21N, R10W, 6240-6260'
Description	From the north side of Fajada Butte, on the west side of the prominence that runs by 29SJ 1360, below the bottom-most exposed sandstone layer. From within a well-entrenched drainage; this sample is from the same stratum as No. 3, but is taken from a more exposed location to the northwest.

DEPOSIT

Formation	Menefee
Description	Because of its exposed location, the clay here does not occur in hard chunks, but in smaller (ca 5 cm diameter) lumps that are weathered. Perhaps because of weathering, the clay is a lighter gray.
Date/by	9/18/81 by Peter J. McKenna and H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water 1:00 p.m. on 10/23/81. Slower breakdown than No. 3; air escapes when stirred. Sticky clumps are present at 3:30 p.m.
Settling	Column started with viscous clay well shaken with water 9:30 a.m. on 10/28. At 9:30 a.m. on 10/29, clay seems to have expanded with mixing or to be held in suspension much longer than is usual. This condition remained until 11/4 in the a.m.; clearly this clay has a strong affinity for water: ca. 2 mm of clear water; 2 mm ± somewhat lighter gray; 43 mm very homogeneous light brown gray; little else is present except for rare dark specks. There was a 3 mm distinct band at bottom of sediment defined mostly by a very thick darker line. The color below the line is otherwise similar with a few more specks.
Wet color	2.5Y 5/2
Hydration	Water allowed to evaporate—standing water was gone by 10/29, but this clay seems to have a much greater affinity for water than the others so far (Nos. 1-3, 5, 7-10). It remained soupy on 10/30 in the a.m. Placed under towels on 10/30 in the a.m. Still sticky and muddy on 11/2 in the a.m. As opposed to No. 3 (collected from very near No. 4), this sample leaves a creamy white deposit on the towels. Still sticky on 11/3 in the p.m.
Tile	No. 4a on 11/4 in the p.m.—9.80 x 4.78 cm. No. 4 on 11/4 in the a.m.—9.65 x 5.07 cm. No. 4b at 8:00 a.m. on 11/5—9.63 x 4.74 cm.
Workability	No. 4 at 8:00 a.m on 11/4. This is the least workable sample yet (Nos. 1-10). It is sticky and does not form well because of it. By skimming away the drier portions, this is slightly ameliorated. No. 4a postponed to allow still further drying. On 11/4 at 3:30 p.m., again an effort made to use only the driest part of the sample and again sticky and unpleasant to work. On 11/5 at 8:00 a.m. No. 4b—worked up one more tile after another night under towels. The clay works somewhat better but it is still sticky. This clay might be okay for mortar, but I wouldn't recommend it for pots.
Polish	No. 4a polished 11/5 at 7:30 a.m., with the center of the tile leathery. It smooths nicely but does not take on a sheen.
Drying	This sample shows more bending and unequal shrinkage than the others. All three tiles seemed to dry intact until nearly dry at which time all developed a major crack through the tile running across near the middle of the tile. No. 4b's crack is less severe. No. 4 eventually broke entirely in half.
Dry color	2.5Y 6/2

Shrinkage Dry size: No. 4a—8.65 x 4.24 cm; 11.73 x 11.30%. 11/9 No. 4—8.51 x 4.40 cm; 11.81 x 13.21%. No. 4b—8.64 x 4.19 cm; 10.28 x 11.60%

FIRING

Temperature No. 4a—910° C ox., 1/26/72; No. 4—1250° C 5/18/82

Fired color No. 4a—7.5YR 7/6 polish very similar. No. 4—5YR 4/4 inside

Fired size No. 4a—8.62 x 4.22 cm. No. 4—8.80 x 4.48 cm (cracked)

Fired properties No. 4a. In spite of the crack going all the way across and which transmitted light before firing, the tile remained in one piece. No other cracks developed. It seems that the clay fires fine once dry. Even with cracks, the tile rings like the others.

No. 4. Dark sheen developed especially on top of tile. Crack surfaces (tile in two pieces) show no sheen and dark brick-like appearance. Minute bubbling apparent around upper edge. Measurements indicate some swelling but length-wise measure is unreliable as the two pieces no longer fit together well.

CLAY SAMPLE DATA: SAMPLE NO. 5

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of NE 1/4 Section 29 T21N, R10W, 6150'
Description	Collected from the Fajada Wash, above the Visitors Center bridge. The material was in the backwash from the 9/17 runoff from the Chaco Wash. Few clay sediments were apparent in the Fajada Wash, but the materials from the Chaco Wash do contain clay.

DEPOSIT

Formation	Alluvial—Chaco Wash headwaters
Description	This sample was taken from the floor of the wash and was still wet.
Date/by	9/18/81 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water at 1:00 p.m. on 10/23/81. Though the sample is still wet at this date, its treatment is similar to that of the dry samples. Whereas all the dry samples are odorless, this one has a strong smell and some varied colors suggesting organic content. Something in this sample stains the plastic dishpan black.
Settling	Column started with mixed viscous material well shaken in water at 9:30 a.m. on 10/28. At 9:30 a.m. on 10/29, more differentiation than in Nos. 1-3, 5, 9, 10. Light brown film on water surface; 11 mm clear water; surface of sediment is irregular, shows organics; 2 mm lighter than bulk, very fine (silt?); 18-32 mm brown, homogeneous; 2-13 mm darker brown in jagged layer at bottom with some pockets of the brown from the above interspersed. Some sort of deposit was formed on the walls of the plastic vial. I thought perhaps it was an algae (11/1), but a permanent yellow stain has been left on the walls of the cylinder.
Wet color	5Y 4/2.
Hydration	Wet when collected. Allowed to evaporate from "soaking" until 10/28 in the a.m., at which point it would hold its form after mixing and was placed under moist paper towels.
Tile	Formed No. 5a at 5:00 p.m. on 10/29—10.13 x 4.69 cm. No. 5 at 11:30 a.m. on 10/29—10.28 x 5.24 cm.
Workability	No. 5—clay perhaps a bit too moist or a bit silty or both; will form a malleable fillet ring. No. 5a formed after further drying. The somewhat less moist material also works differently from the other samples—it is more pliable (still too moist?).
Polish	At 7:30 a.m. on 10/30, No. 5a appears leathery but does not take polish well—smears rather than polishes. At 10:30 a.m., a much more normal polishing response.
Drying	Both tiles look uniform and good with no cracking.
Dry color	10YR 6/2; polished 10YR 5/2
Shrinkage	Dry size: No. 5a—9.44 x 4.48 cm; 6.81 x 4.48%. No. 5—9.46 x 4.92 cm; on 11/13 7.98 x 6.11%.

FIRING

Temperature	No. 5a—910° C, ox., 1/26/82. No. 5—5/18/82, 1250° C.
Fired color	No. 5a—7.5YR 7/6, polished; 5YR 6/6 (appreciable difference). No. 5—2.5YR 3/4.
Fired size	No. 5a—9.44 x 4.47 cm. No. 5—8.62 x 4.51 cm. Mean: 8.88 x 8.33%
Fired properties	No. 5a appears to be excellent. No cracking, sounds good. This tile seems less damaged than many of the others. No. 5 has a high sheen on surface and interior. Further shrinkage, looks well consolidated, dark ring on top edge.

CLAY SAMPLE DATA: SAMPLE NO. 6

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of NE 1/4 Section 29 T21N, R10W, 6140'
Description	Collected from the Fajada Wash, from under the Visitors' Center bridge, from near where the park maintenance crew takes out gravel for the roads. The sample came from the south wall of the wash (see Love 1977:Figure 12). The soaked portion contained one subround piece of fine sandstone, ca. 2 cm.

DEPOSIT

Formation	Alluvial
Description	Clay is present in 25 cm blocks of pure clay in the alluvial lenses of gravel and sand.
Date/by	9/18/81 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water at 3:30 p.m. on 10/30/81; at 5:00 p.m. on 10/31 breaking down but leaves plates. By 11/4 is quite smooth and easily mixed.
Settling	Column started at 9:00 a.m. on 11/4 from viscous clay. As with No. 4, once in suspension, this sample settles very little. There is more differentiation than in No. 4, but this sample also shows expansion in water. The clay level is considerably higher after mixing with water than before. On 11/5 at 9:00 a.m. there was no surface film; 9 mm clear, transparent water; ca. 2.5 mm at top of sediment is lighter, finer than bulk; 32-38 mm (nearly to bottom in some places) brown-gray clay with some minute black specks; < 1-4 mm denser deposit but similar in color in irregular layer at bottom; lacks specks.
Wet color	2.5Y 5/2
Hydration	Standing water allowed to evaporate; mixed and placed under towels on 11/5 at 9:00 a.m.
Tile	Formed at 4:30 p.m. on 11/6: No. 6a—9.86 x 4.74 cm. No. 6—9.93 x 5.23 cm (by PJM).
Workability	Workable but not wonderful—somewhat sticky, but better than No. 4. It would be possible to form a pot from this clay.
Polishing	Not polished.
Drying	No. 6 developed a 22 mm crack on one side, not as severe as those in No. 4, but in a similar location—transverse near mid-tile. No. 6a dried in good condition.
Dry color	5Y 7/2
Shrinkage	Dry size: No. 6a—8.71 x 4.14 cm; 11.66 x 12.66%. No. 6—8.72 x 4.57 cm; 12.19 x 12.62%.

FIRING

Temperature	No. 6a—910° C, 1/26/82. No. 6—1250° C, 5/18/82
Fired color	No. 6a—7.5YR 7/4. No. 6—10YR 5/4
Fired size	No. 6a—8.66 x 4.11 cm; No. 6—8.74 x 4.63 cm; +0.2 x 1.3% expansion
Fired properties	No. 6a—intact, no cracks, rings when struck. This sample seems especially dry. No. 6—crack did not aggravate, very slight increase in dimensions; especially top shows pores with glassy droplets around them.

CLAY SAMPLE DATA: SAMPLE NO. 7

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of SW 1/4 Section 21 T21N, R10W, 6220-6240'
Description	Northeast of Una Vida at the top of the first talus, from near the head of a small gully that opens onto the flood plain just east of the ruin.

DEPOSIT

Formation	Menefee
Description	Dark gray stratum with selenite seams; directly below light sandstone outcrop. The highly laminar nature of this clay gives it a shard-like appearance in the fragmented dry form.
Date/by	9/19/81 by H. Wolcott Toll and Hayward H. Franklin

TREATMENT

Soaking	Placed in tap water at 3:30 p.m. on 10/30/81. There is substantial crystal formation at the evaporation line on 11/4, crystals reintroduced. Allowed to get overly stiff; more water added and mixed on 11/9. One piece of selenite 1-2 cm in the soaked portion.
Settling	Column started from viscous clay on 11/9 at 8:00 a.m. On 11/10 at 1:30 p.m., no surface film present; 13 mm clear water with virtually no color; 3 mm slightly lighter than bulk at the surface of the sediment; 30 mm very homogeneous grayish brown clay with a few visible interstitial spaces and one 11 mm eye-shaped area of lighter deposit at the middle of this section (may be clay stuck to the vial wall); 1 mm faint hint of darker sediment at the bottom, but very little in the way of black material.
Wet color	10YR 4/2
Hydration	Water added after over drying, though the clay was still moist; remixed and placed under towels on 11/9 a.m.
Tile	Formed at 1:15 p.m. on 11/10: No. 7a—4.74 x 9.94 cm. No. 7—4.80 x 9.99 cm.
Workability	Works nicely, if slightly stickily; rare small inclusions are present that drag when scraped.
Polishing	Takes polish well; leather hard on 11/11 at 9:15 a.m.
Drying	Tiles dried for two days with top side up, and differential color between bottom and top became apparent as in No. 8. While the bottom side was still damp, they were turned over (11/12 a.m.). On 11/13 in the a.m., the centers of the top side of the tiles had taken on the lighter color of the bottom, while the bottom retained the lighter color. The edges and the perimeter of the top side (now down) are dark with a narrow grading zone of color between light and dark. On 11/13 in the a.m., No. 7 was turned top side up and No. 7a was left top side down. Perhaps the screen during the final drying did not alter the coloration of the tiles, irrespective of which face was up. This must be some leeching product. One 8 mm transverse hairline crack on the top of No. 7. Drying otherwise looks good.
Dry color	Center/bottom. 10YR 6/1. Polished slightly darker. Edges - 10YR 3/1 - 4/1. Gradation 7.5YR - 6/2
Shrinkage	Dry size: No. 7a—8.72 x 4.12 cm; 12.27 x 13.08%. No. 7—8.81 x 4.22 cm; 12.08 x 11.81%.

FIRING

Temperature	No. 7a—910° C, ox. 1/26/82. No. 7—1250° C, 5/18/82
Fired color	No. 7a—10YR 8/3 bottom. Rind—10YR 8/2-9. Polish same. No. 7—10YR 8/6
Fired size	No. 7a—8.60 x 4.05; 1.4 x 1.7% further shrinkage. No. 7—8.79 x 4.50 x 2.3 thick + (6.64 x 0.23); 6.64% expansion x 1.0% shrinkage x 230% expansion

Fired properties No. 7a—crack-free, good, rings when struck. Measurements indicate more than usual change from dry state. Some length-wise warp is visible, but I'm not sure if it's from firing. No. 7—numerous marked changes in 1250° C firing. Center of tile bloated to ca. 2.3x original thickness, marked width lengthwise warp (length slightly less or 6.6% more), frothy and pumice-like in section; numerous blisters on surface, rind on top edge is white and shows streaks and cracks reminiscent of the ridges of a finger print or elephant skin.

CLAY SAMPLE DATA: SAMPLE NO. 8

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of SW 1/4 Section 21 T21N, R10W, 6280-6300'
Description	Taken from directly above the east wing of Una Vida, from the same stratum as No. 9 at the base of the largest visible cliff, above the talus to the ruin. There is a small ledge next to the deposit. Sample No. 9 was taken about 50 m to the west and No. 7 about 40' down section.

DESCRIPTION

Formation	Top of the Menefee (Cliff House?)
Description	Clay comes from a thick, shaley layer that contains selenite, sulphur and sandstone lenses as well as clay.
Date/by	9/19/81 by H. Wolcott Toll and Hayward H. Franklin

TREATMENT

Soaking	Placed in tap water at 3:30 p.m. on 10/30/81; within two hours breaking down, but more slowly than some. A crystalline deposit formed at the water line by 11/2 a.m.; much of the crystalline material was replaced in the clay. On 11/3, a great deal of platy structure is still visible. When mixed on 11/4 in the a.m., larger plates are less evident, but much particulate material is still present.
Settling	Column started from viscous clay on 11/4 at 9:30 a.m. In contrast to No. 4 and No. 6, this sample settles rapidly. On 11/5 at 9:15 a.m., slight surface film; 23 mm nearly clear water; a very slight murkiness is present; 6 mm distinctly lighter but still dark brown band of fine deposit. There are some vertical tracks suggesting that particles of the heavier, darker main deposit may have dropped through. There were 22-24 mm of dark brown deposit that grades from top to bottom (less to more) in the amount and size of interstitial spaces visible at the bottom. The spaces are up to 1 mm in size. At the bottom of this layer, there is a yellow sliver 3 mm long. 1-6 mm at bottom of very slightly lighter irregular deposit without interstitial spaces.
Wet color	10YR 3/2
Hydration	Standing water evaporated by 11/5 in the a.m.; placed under damp towels.
Tile	Formed 11/6 at 8:00 a.m.: No. 8a—9.64 x 4.89 cm. No. 8—9.81 x 4.88 cm.
Workability	Works quite well; contains quite a bit of platy stuff which gives an unsmoothed surface a grainy look and which also makes scraping odd, and which may hurt cohesiveness somewhat, though a fillet ring can be formed. Graininess also makes incising look irregular.
Polishing	The leather hard stage was not observed; some minimal attempt to polish when the clay was slightly too wet suggested that the clay would polish well.
Drying	Both tiles dried nearly without cracking. No. 8 has one 5 mm crack on one edge.
Dry color	This sample shows a very unusual drying color. The tops of the tiles, which were left up during the drying, are a deep dark chocolate brown, while the down surfaces are very much lighter. The edges grade from dark to light and if small grains are removed from the upper surface, the color underneath is the light brown of the bottom. Top 10YR 2/2-3/2; polished 10YR 3/2-4/2; bottom 10YR 6/2.
Shrinkage	Dry size: No. 8a—8.71 x 4.39 cm; 9.65 x 10.22%. No. 8—8.90 x 4.46 cm; 9.28 x 8.61%.

FIRING

Temperature	No. 8a—910° C, oxidized 1/26/82. No. 8—1250° C, on 5/18/82
Fired color	No. 8a—top 7.5YR 8/2 or 9/2 polish the same. Bottom 10YR 8/3. No. 8—10YR 8/6

Fired size	No. 8a—8.68 x 4.39 cm. No. 8—8.80 x 4.67 x 1.6 cm thick; -1.12 ca x + 4.71% + 60%
Fired properties	No. 8a—This sample is the most dramatic example of the dark leeching product turning nearly white. Also, perhaps associated with this substance is a very fine cracking over much of the upper stained surface. Otherwise, the tile seems intact and does not sound cracked. No. 8—Again, the leech product is very light, the bottom shows a grayish cast (±10YR 5/2) and the interior a light buff (10YR 8/6). There is no obviously bloated area but the tile increased in thickness and width with minor lengthwise warp. Interior shows slightly frothy texture.

CLAY SAMPLE DATA: SAMPLE NO. 9

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of SW 1/4 Section 21 T21N, R10W, 6280-6300'
Description	Taken directly from above the east wing of Una Vida, from the same stratum as No. 8, at the base of the largest visible cliff above the talus to the ruin. There is a small ledge next to the deposit. Sample No. 8 was taken about 50 m to the east.

DESCRIPTION

Formation	Top of the Menefee (Cliff House?)
Description	A fine, hard, blocky, homogeneous layer of clay that has the appearance of having possibly been dug before. The clay is a very dark gray.
Date/by	9/19/81 by H. Wolcott Toll and Hayward H. Franklin

TREATMENT

Soaking	Several lumps placed in tap water about 2:30 p.m. on 10/12/81. At 1:30 p.m. on 10/13, small plates remain; these can be broken down with the fingers. Small unidentified fibrous organic fragments float off. At 8:30 a.m. on 10/14—quite a bit of platy material remains. This sample is similar to No. 1 in this respect, but this one contains more of this platy stuff.
Settling	At 8:30 a.m. on 10/14—placed in 5 cm column after thorough stirring; plates do not pour off. At 10:15 a.m. on 10/15, 28 mm nearly colorless water with a few specks at the surface. Also, there was 21 mm of very dark gray-brown clay, the top 3 mm of which are slightly lighter; 3 mm of increased density of black specks. A second column was started 10/21 a.m. using mixed, plastic clay placed in column and shaken with water; no further separation was visible.
Wet color	7.5YR 4/2
Hydration	Left under standing water which was allowed to evaporate; water gone by 10/21 a.m.; placed under damp paper towels. Clay remaining after tile formation placed in plastic on 10/22 p.m.
Tile	Two formed 10/22 at 5:00 p.m.: No. 9a—10.09 x 4.93 cm. No. 9—10.74 x 4.79 cm.
Workability	This clay seems to work well and is homogeneous to the touch. When scraped, a rough-looking surface results, presumably from the platy nature of the clay noted when soaking. This roughness is easily erased with a wet finger. It is possible to form a coil—small cracks form but adding water remedies the problem.
Polishing	Polished ca. 3x3 cm area of 9a when leather hard on 10/23 at 1:00 p.m. The platy/rough surface is easily and completely smoothed by polishing.
Drying	Dry without cracks by 10/27 or 10/26.
Dry color	10YR 6/2; polish 10YR 4/2
Shrinkage	Dry size: No. 9a—9.05 x 4.32 cm; 10.31 x 12.37%. No. 9—9.53 x 4.18 cm; 11.27 x 12.73%.

FIRING

Temperature	No. 9a—910° C, ox., 1/26/82; No. 9—1250° C, 5/18/82
Fired color	No. 9a—7.5YR 7/4. No. 9—10YR 4/2
Fired size	No. 9a—8.98 x 4.32 cm; No. 9—8.83 x 3.92 x 1.8 cm thick; 7.34 x 6.22% further shrinkage
Fired properties	No. 9a—Three 5 mm hairline cracks are now present on the bottom of this tile; appearance and sound are otherwise good. No. 9—length and width have decreased but the center of the tile has increased in thickness about 80%. This bloat caused long stretch cracks on both top and bottom, similar to No. 11. Tile has a glassy gray side. On the sides and top there is a

thin buff residue(?) through which the gray is visible. The tile is now very hard and breaks conchoidally.

CLAY SAMPLE DATA: SAMPLE NO. 10

LOCATION

Quad	Kin Klizhin Ruins, NM 1966
Legal	SW of NW of Section 30, T21N, R11W, 6140'
Description	North of the road to Kin Klizhin from South Gap, less than a quarter mile east of the west monument boundary fence; just west of a large Navajo corral (Site 29SJ 448?) and east of a smaller one.

DEPOSIT

Formation	Menefee
Description	A thick layer of hard clay that reaches at least 2 m; extensively exposed beneath a sandstone cap. There are some very coarse deposits in the sandstone containing pebbles up to 4 cm in diameter. Coal and other small seams of nonclay lenses are present in the layer.
Date/by	9/20/81 by H. Wolcott Toll

TREATMENT

Soaking	On 9/22-24/81 soaked in tap water; initial breakdown is quite rapid (5-10 cm lumps completely dissolved in less than two hours) without pulverization. Clay is generally homogeneous but contains subrounded lumps of sandstone up to 6 mm in diameter. The sandstone has both black (magnetitic?) and white matrix—grains are fine and include some pink feldspar.
Settling	Completely stirred a solution of clay after 24 hours of soaking; poured into vial, but rare coarse particles did not pour off. After 24 hours covered: 9 mm clear water; 40 mm homogeneous brown clay; <1 mm fine black specks (coal?) at bottom.
Wet color	2.5Y 5/3
Hydration	Let sit in plastic until the morning of 9/29. Let sit in moist towel until the p.m. of 9/29. For second tile clay from original soaking, kept in plastic bag until 10/12/81.
Tile	On 10/12 No. 10a—9.90 x 5.12 cm. No.10—10.08 x 5.16 cm on marked edges by ca. 1 cm thick 9/29.
Workability	The clay seems very workable and good. After extra hydration in plastic, the qualities seemed even better.
Polishing	3 x 3 cm area polished on No. 10a—creates a darker area, takes a good polish.
Drying	On 10/5 tile shows no drying cracks at all and is to all appearances cohesive and good.
Dry color	2.5-5Y 7/2; polished area 2.5Y 5/2.
Shrinkage	No. 10a—8.76 x 4.51 cm; on 10/5 11.52 x 11.91%. Mean: 12.06 x 11.66%. No. 10—8.89 x 4.53 cm when dry; 10/5—11.81 x 12.21%.

FIRING

Temperature	No. 10a—910° C, 1/26/82. No. 10—1250°, C 5/18/82
Fired color	No. 10a—7.5YR 6/6-7/6; polish 7.5YR 6/6. No. 10—5YR 4/3
Fired size	No. 10a—4.48 x 8.76 cm (with mark indistinct). No. 10—4.44 x 8.49 cm; -1.99 x 4.50%
Fired properties	No. 10a—Looks excellent, sounds good. No. 10—Dark, very shiny appearance; no bloating but some width-wise warp has occurred; drainage minimal.

See mix of 21 + 10.

CLAY SAMPLE DATA: SAMPLE NO. 11

LOCATION

Quad	Kin Klizhin Ruins, NM 1966
Legal	SW 1/4 of SW 1/4 Section 24, T21N, R12W (perhaps SE of SE Section 23) 6080'
Description	Northwest of the ruin of Kin Klizhin, across the flat drainage bottom and through the rounded, badland-like hills northwest of the loading shute, below exposed bedrock.

DEPOSIT

Formation	Menefee
Description	A thick stratum below a sandstone cap; the best clay seems to be at the base of the heavily eroding non-sandstone deposit below the cap. Clay may have been removed from this location before.
Date/by	9/19/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 11/6/81 in the a.m. Much black stuff floats; little/no crystal formation at the water line. Water evaporated by 11/16 in the a.m.; mixed—smooth consistency but various colors are present—dark browns, golds, predominantly brown.
Settling	Column started from viscous clay on 11/16 at 8:30 a.m. At 8:30 a.m. on 11/17, surface film in clumps; 7 mm of transparent yellow water ± 10YR 7/8; 4 mm fine, clean sediment, lighter than bulk; 36 mm homogeneous light yellowish-brown clay with abundant black specks; 0-1 mm layer of dense black specks at bottom. This looks to be a clay that expands in water somewhat like No. 4 and No. 6, but less so than those samples.
Wet color	10YR 5/2
Hydration	Water allowed to evaporate. Placed under towels on 11/16 in the a.m.
Tile	Formed on 11/17 at 3:30 p.m.: No. 11a—9.80 x 4.93 cm. No. 11—9.80 x 5.00 cm.
Workability	Slightly sticky, but easily filleted and coiled—good, but not as good as No. 12.
Polishing	Slower to go leather hard than No. 12. Again, this sample seems to be hydrophilic. At 12:00 p.m. on 11/18, leathery—polishes well.
Drying	Slower drying than No. 12. Dries crack free, very slight rinding color around upper edges.
Dry color	2.5Y 6/2-7/2. Polished 10YR 5/2.
Shrinkage	Dry size (11/22): No. 11a—8.57 x 4.25 cm; No. 11—8.66 x 4.26 cm; 11.63 x 14.80%; 12.55 x 13.79%

FIRING

Temperature	No. 11a—910° C, 1/26/82. No. 11—1250° C, 5/18/82
Fired color	A lighter rind color is present around top edge, polish same color as rest of tile. 7.5YR 7/6; rind 7.5Y 8/4. No. 11—5YR 5/4.
Fired size	No. 11—7.98 x 4.04 x 1.8 cm thick; -5.16 x 7.85% further shrinkage
Fired properties	No. 11a—looks good; crack free; sounds sound. No. 11—again, a decrease in dimensions with bloating in the center. The tile now looks like it encases a finger and has increased from about 1 cm in thickness to 1.8. The reaction is similar to No. 9, but no cracks developed. The color "rind" is visible now as an almost gold rim.

CLAY SAMPLE DATA: SAMPLE NO. 12

LOCATION

Quad	Kin Klizhin Ruins, NM 1966
Legal	SW 1/4 of NE 1/4 Section 25, T21N, R12W (perhaps SE of SE Section 23) 6080'
Description	SE of the ruin of Kin Klizhin, across the wash, on the lower scarps of the valley.

DEPOSIT

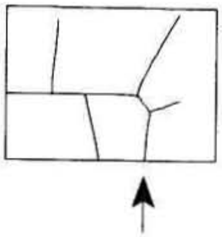
Formation	Menefee
Description	A thick stratum below a sandstone cap which runs along the side of the valley here; a sandstone cap is present but does not fully protect the stratum. The clay is hard.
Date/by	9/19/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 11/9/81 at 3:30 p.m. Retains form but absorbs water; easily spread out on 11/10 at 8:00 a.m. Water evaporated on 11/16 in the a.m.; mixed—this sample has a grainy appearance when mixed. A spatula leaves a smoother appearance, though some large lumps are visible. No crystal formation.
Settling	Column started on 11/16 in the a.m.; viscous plates present. At 8:45 a.m. on 11/17 surface film is very scant; a few black specks; 19 mm of yellow water; transparent, ca 10YR 7/8; 3 mm of fine, lighter colored sediment; 23 mm of homogeneous light yellow-brown clay with some very minute black specks; far fewer than No. 11; 3 mm of increased very small specks separated in a very distinctly demarcated band. One darker, clay plate clump is visible at the bottom, as well.
Wet color	2.5Y 4/2
Hydration	Water evaporated by 11/16 in the a.m., but the clay is still wet; covered with towel at 12:00 p.m. on 11/16. The towels take on a considerable yellow stain.
Tile	Formed on 11/17 at 2:30 p.m.: No. 12a—9.94 x 5.02 cm. No. 12—error message: not measured.
Workability	This is good stuff—readily forms fillets and coils. Some platy remnants may be felt and cause drag marks when scraped, but they are easily removed with a wet finger.
Polishing	Leather hard on 11/18 at 10:30 a.m., takes polish well.
Drying	Nearly dry by 9/19 in the a.m. Dry, almost crack free, but No. 12 shows small crack at one end possibly from an inclusion. Some rind on No. 12a around upper edge.
Dry color	10YR 6/2. No. 12 smoothed with wet finger when wet and shows no rind. Polished 10YR 5/2.
Shrinkage	Dry size (11/22): No. 12a—9.06 x 4.51 cm, 8.85 x 10.16%. No. 12—8.98 x 4.50 cm, no wet measurement.

FIRING

Temperature	No. 12a—910° C, ox., 1/26/82. No. 12—1250° C, 5/18/82.
Fired color	No. 12—2.5YR 4/4. No. 12a—7.5YR 7/6.
Fired size	No. 12a—8.97 x 4.53 cm. No. 12—2.5YR 4/4. No. 12a—Unlike the rind on the other tiles, this one turned markedly redder (instead of lighter). 7.5YR 7/6; rind 2.5YR 6/8. No. 12—Shiny and dark with darker rim. Some minor bubbling at rim. Little change, some possible width-wide warp. 2.8-3.0%. Further shrinkage, no bloating. No. 12—8.73 x 4.37 cm; 2.78 x 2.89% further shrinkage.
Fired properties	No. 12a has developed a crack system on the back side. The cracks are very fine and quite well- spaced. Rather than being star-like are rectilinear. Only the one marked extends



through the tile.

CLAY SAMPLE DATA: SAMPLE NO. 13

LOCATION

Quad	Kin Klizhin Ruins, NM 1966
Legal	NE 1/4 of NE 1/4 Section 26, T21N, R12W 6060'
Description	West of the ruin of Kin Klizhin, from around the stock pond in the tributary wash next to the site.

DEPOSIT

Formation	Alluvial
Description	Warren reports collecting a red firing clay from (we think) this location. This material was taken from the bottom, banks, and flats below the stock pond. Pure clay was hard to find since much sand is intermixed.
Date/by	9/19/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 11/9/81 at 3:30 p.m. Seeds (?) and other vegetal material float off. Water evaporated on 11/16 in the a.m.; the sandy texture is very evident when the sample is mixed.
Settling	Column started on 11/16 at 8:30 a.m. About 1 cm of sandy material settles almost immediately and much organic goes to the surface. On 11/17 at 9:00 a.m.—no surface film, but there is a dense deposit of organics around the walls of the vial—ca. 5 mm; 22 mm of somewhat cloudy, pale, yellow water (ca. 10YR 8/4). Some waterlogged organics on surface of sediment; 19 mm of fine, clayey, light brown gray sediment with rare small specks (could be silt?); 3 mm similar consistency but very much darker; close in color to underlying sand, but lacks black particles. 7 mm very fine sandy sediment; various colors but mostly brown with some black particles (ca. 10YR 5/3).
Wet color	10YR 5/2
Hydration	Placed under towels on 11/16 in the a.m.; under plastic on 11/16 in the p.m.
Tile	Formed on 11/17 at 1:00 p.m.: Formed on 11/17 at 2:30 p.m.: No. 13a—10.10 x 5.06 cm. No. 13—10.24 x 4.54 cm.
Workability	The sandiness of this sample impairs its cohesion as the coils tend to break. It can, however, be formed into a tile easily. The organics tend to affect incising; scraping is less effective than with clayier samples.
Polishing	On 11/18 at 7:30 a.m.: No. 13a—still damp, but probably more than leather hard. The sandy consistency making this more difficult to judge. Polishing this tile is the first time a sheen has been imparted to the polisher; audible grinding takes place. The resulting polish is good.
Drying	Dries quickly with visibly less shrinkage than other samples. Smooth and crack free when dry.
Dry color	2.5Y 7/2-7/3. 10YR 6/3 polished.
Shrinkage	Dry size (11/22): No. 13a—9.63 x 4.96 cm; 4.65 x 1.98%. No. 13—9.73 x 4.49 cm; 4.98 x 1.10%. Mean: 1.05 x 4.82%

FIRING

Temperature	No. 13a—910° C, ox., 1/26/82
Fired color	No. 13a—5YR 6/6
Fired size	No. 13a—4.95 x 9.50 cm
Fired properties	No. 13a—crack free; good.

CLAY SAMPLE DATA: SAMPLE NO. 14

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of SW 1/4 along Section Line, Section 22/21 T21N, R10W, 6260'
Description	North canyon cliff face approximately 1,000 meters SW of Gallo Campground entrance. Roughly on the same level with and slightly SW of site 29SJ 1423.

DEPOSIT

Formation	Menefee
Description	Clay layer ca. 2-1 meters thick and extensively interfingered with sandstone layers. Clay color varies from light gray-brown black with considerable yellow (sulphur) intermixed and visible along clay bedding seams. The structure is highly laminar.
Date/by	9/18/81 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water on 11/10 at 4:30 p.m. Slow to break down; laminar structure remains but clay is absorbing on 11/11 at 9:00 a.m. On 11/12 in the p.m., this clay retains laminar structure longer than any of the other samples (Nos. 1-13). There is a heavy crystal formation at the water line. On 11/17 in the a.m., plates can be broken up but retain shape; mixed some. On 11/20, after periodic mixing and comminution on 11/18-19 and mixing on 11/20 in the a.m., the sample has the consistency of oatmeal, i.e., lots of lumps, but none large.
Settling	Column started at 8:00 a.m. on 11/20 from mixed "oatmeal" clay. There is a substantial portion that is in clumps and did not go into solution. A transparent band of water appeared at the top of the column within minutes. On 11/22 at 4:30 p.m., a few specks on the surface, no film; 18 mm transparent, very slightly yellow water; ca. 1 mm lighter fines on top of the sediment; 19 mm homogeneous brown with very minute, rare black specks; one 11 mm vertical darker settling track; 10-12 mm coarser, darker sediment with spaces; some yellow particles; 0-1 mm denser dark material at bottom.
Wet color	10YR 3/2
Hydration	Placed under towels on 11/20 in the a.m.; under plastic on 11/20 in the p.m.; 11/22 in the p.m., still sticky. Towels only on 11/22 in the p.m. This is the longest period of soaking and hydration allowed for any sample. This material might benefit from grinding.
Tile	Formed on 11/23 at 2:00 p.m. No. 14a—9.93 x 4.80 cm. No. 14—9.70 x 4.60 cm. No. 14b—10.05 x 4.98 cm.
Workability	The lumpy nature of this sample is very evident. A fillet can be formed but tends to break when bent due to the coarse nature of the clay. No. 14b was formed first; cracks were present, perhaps a bit too dry. No. 14 formed from somewhat damper clay; works a little better, but still has problems. A very presentable looking tile can be produced by wetting and smoothing. No. 14a more water was added, which improves working character, but a coarse tile still results. All three scrape with difficulty and incise poorly because of lumps.
Polishing	Back sides of Nos. 14a and 14b polished. On 11/24 at 8:00 a.m., leather hard (tops drier). The tiles polish fine and the roughness of the clay can be compensated for. Rock inclusion projects through in No. 14b.
Drying	As this sample dries, it takes on a mottled appearance, presumably from the lumps present below the surface (surfaces were homogeneous color in the wet tiles). Each tile shows several small crack systems; especially Nos. 14 and 14a near the center of the tile. Most on No. 14, worst on No. 14a around large inclusion.

Dry color	Tiles are slightly mottled; all have distinct dark rind and some mid-tile dark coloration. Center: 10YR 6/2-7/2. Polished: 2.5Y 3/2-4/2. Rind: 10YR 3/2
Shrinkage	Dry size: No. 14a—9.19 x 4.44 cm; 7.45 x 7.50%. No. 14—9.14 x 4.31 cm; 5.77 x 6.30%. No. 14b—9.26 x 4.56 cm; 7.86 x 8.43%.

FIRING

Temperature	No. 14a—910° C. No. 14—1250° C
Fired color	No. 14a—5YR 7/4
Fired size	No. 14a—9.16 x 4.43 cm
Fired properties	Not recorded.

CLAY SAMPLE DATA: SAMPLE NO. 15

LOCATION

Quad	Sergeant Ranch, NM 1966
Legal	NW 1/4 of SE 1/4, Section 13 T21N, R10W, 6290'
Description	North side of Gallo Canyon in first rinconito NE of first large (N) lateral drainage of Gallo Wash outside the monument. In cliff face seam north of two stock tanks on Quad Map and fronted by a small, unsurveyed late Pueblo III site.

DEPOSIT

Formation	
Description	Clay layer is similar in color and composition to No. 14, less the sandstone interfingering. Layer is ca. 0.5-1.0 meters thick and was possibly used prehistorically as a clay source.
Date/by	9/18/81 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water on 11/18/81 at 9:15 a.m. Quick to break down; deformed without help by 10:30 a.m. Placed under plastic on 11/23 at 2:30 p.m. Removed on 11/30 in the a.m. No crystals formed at water line.
Settling	Columns started on 12/1 at 9:00 a.m. On 12/2 at 9:40 a.m., no surface film; 18 mm transparent, nearly clear (very slightly clouded) water; 3 mm very slightly lighter colored, finer sediment; 20-23 homogeneous brown sediment with several darker settling tracks; no specks. 5-7 mm somewhat coarser with interstitial spaces and some yellow specks; 0-1 mm dark layer with black specks.
Wet color	2.5Y 4/2
Hydration	Placed under towels on 12/2 in the a.m. when the clay had become quite stiff.
Tile	Formed on 12/2 at 10:50 a.m. No. 15a—10.30 x 5.38 cm. No. 15—10.56 x 5.17 cm.
Workability	This sample works very well. Forms fillets, coils, pinch pots with ease; perhaps slightly sticky. Small sandstone (?) inclusions cause occasional scraping and incising difficulties.
Polishing	Moist-leatherhard at 9:15 p.m. on 12/2. Polishes well, inclusions grate but can be ground smooth. One such inclusion left a yellow ochre-colored spot.
Drying	Mostly dry by 12/4 in the p.m. Cracks developed earlier in No. 15a than No. 15. Late in drying in No. 15. On 12/6 in the p.m., several crack systems developed in No. 15a, most around visible inclusions. At the top side, upper end, is a serious one through the edge and extending 2 cm down the tile. Lesser cracks 0.5-0.7 cm long elsewhere. No. 15 also has numerous cracks including one through edge extending 1 and 1.5 cm into tile; inclusions again to blame for some of the cracking.
Dry color	Quite uniform (no leeching) water-smoothed. No. 15 slightly lighter and slightly dappled. 10YR 6/2 polished similar but very slightly darker.
Shrinkage	Dry size: No. 15a—9.24 x 4.83 cm; 10.29 x 10.22%. No. 15—9.35 x 4.61 cm; 11.46 x 10.83%. Mean: 10.53 x 10.88%

FIRING

Temperature	No. 15a—910° C, ox., 1/26/82.
Fired color	No. 15a—5YR 7/6, polish the same.
Fired size	No. 15a—4.83 x 9.21 cm.
Fired properties	No. 15a—drying cracks have perhaps widened somewhat but do not seem to have lengthened. Inclusions visible have turned a dark red. The topside has a grainy appearance because of numerous white specks formed by a probable leeching product that has turned white.

CLAY SAMPLE DATA: SAMPLE NO. 16

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	SW 1/4 of NE 1/4 Section 12 T21N, R11W, 6460'
Description	A sample of native clay from beneath Plaza 2 at Pueblo Alto; NW 1/4 of NW 1/4 of Plaza 2 Grid 205, below Layer 2. 29SJ 389 FS 3477.

DEPOSIT

Formation	Lewis Shale.
Description	A white clayey substance thought to be a breakdown product from the bedrock. There is a great deal of aeolian sand intermixed with this sample.
Date/by	7/25/77 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 11/18/81 at 9:15 a.m. Rootlets float to surface. Placed under plastic on 11/23 at 2:30 p.m. Plastic removed on 11/30 in the a.m.
Settling	Column started on 12/1 at 8:40 a.m. Rapid settling of sandy portion and rising of roots to surface. On 12/2 at 9:50 a.m., dense band of rootlets up to 3 mm wide around vial at surface; no other film visible on surface; 20 mm transparent, nearly colorless water; 2.5 mm lighter, yellowish-fine sediment; 4 mm of slightly darker yellowish sediment without sand; ca. 10 mm yellow brown with very very fine dark sand liberally interspersed; 3 mm similar color but less sand; 6 mm darker yellow brown with very fine (but coarser than above) dark sand grains.
Wet color	10YR 6/4
Hydration	Placed under towels on 12/1 at 8:40 a.m.
Tile	No. 16a—9.98 x 4.74 cm. Formed on 12/2 at 10:15 a.m. No. 16—10.43 x 4.61 cm.
Workability	Sandy; a fillet will form, but coils tend to break. A pinch pot can be formed with continuous water smoothing. Cohesiveness seems to be a problem; scrapes poorly.
Polishing	Leather hard on 12/2 at 9:15 p.m. Polishes with audible grinding. Requires a smooth polishing stone for good result.
Drying	Dried quickly relative to No. 15, which was dried at the same time. No drying cracks.
Dry color	5Y 7/3, polish the same. Uniform color.
Shrinkage	Dry size: No. 16a—9.49 x 4.54 cm; 4.91 x 4.22%. No. 16—9.88 x 4.52 cm; 5.27 x 1.95%. Mean—5.09 x 3.09%

FIRING

Temperature	No. 16a—910° C, 1/26/82. No. 16—1250° C, 5/18/82
Fired color	No. 16a—back--2.5YR 6/6 to probable 7/6 (no color chip). Polish 2.5YR 5/6. No. 16—10YR 8/3 on bottom; top darker and more variable.
Fired size	No. 16a—4.58 x 9.50 cm. No. 16—4.34 x 9.79 cm
Fired properties	No. 16a crack free; sounds good. By 10/27/82; however, No. 16a had developed extensive hairline cracks, many of which seem to relate to white inclusions (seems likely to relate to changes in humidity affecting the inclusions). These cracks are severe enough to threaten a break-up of the tile. No. 16 is more or less unaltered by high temperature; some very small black spots suggesting vitrified particles. Analogous cracking has not developed in the higher fired tile (12/31/82).

CLAY SAMPLE DATA: SAMPLE NO. 17

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NE 1/4 of SE 1/4 Section 12 T21N, R11W, 6280'
Description	Taken from the drainage that comes from Jackson's staircase and runs to Chetro Ketl, from the vicinity of the large prehistoric "retaining walls." Collected from east of the confluence of the drainage that comes from the largest of these walls. Taken from the base of the 7-8 m-thick sandstone stratum on which the discontinuous alignments/walls sit.

DEPOSIT

Formation	Cliff House.
Description	Two clayey bands are present. The lower is ca. 75 cm thick; the upper 15-20 cm—separated by 30-50 cm of sandstone. The upper band contains many fossil tunnels, the lower sandstone lenses and selenite.
Date/by	9/19/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 11/18/81 at 1:15 p.m. Small white particles float to surface and stay there for days without sinking. Under 30-45x lens, these show a fibrous make-up which reminds me of asbestos, but that's a guess if there ever was one (and not a mineralogically very good one either). Very smooth texture; seems slow to release water; no crystals form at water line.
Settling	Column stated on 12/2 at 8:00 a.m. On 12/3 at 9:00 a.m., very faint film on the surface; 22 mm clear, transparent water; clouding minimal; 4 mm lighter and finer sediment; 22 mm very homogeneous brown sediment; other than a few specks (both light and dark). This is one of the most homogeneous samples. Even the small lens of dark specks at the bottom is absent. It is notable that this sample does settle more than did No. 4.
Wet color	2.5Y 5/2.
Hydration	Placed under plastic on 11/23 at 2:30 p.m, removed on 11/30 in the a.m. Placed under towels on 12/2 at 9:30 p.m.; still wet though no standing water remains. Towels very wet on 12/3 in the a.m.; placed under plastic on 12/4.
Tile	Formed on 12/6 at 6:45 p.m. No. 17a—9.78 x 4.88 cm. No. 17—9.57 x 5.07 cm.
Workability	Works nicely; some fairly large inclusions cause scraping drag marks. There are rare ochre-colored inclusions.
Polishing	Leather hard on 12/7 at 7:45 a.m.; polishes well.
Drying	Dry by 12/9: No. 17a seems to have warped some (note the difference in shrinkage). No. 17a also has two sets of cracks near each other on the back side. Long dimensions are 10 and 15 mm—look like they may center on inclusions, but these are not visible. Only two small (3-5 mm) cracks on top of No. 17.
Dry color	Thin, but very distinct ring around the rim of each tile. 2.5Y 6/2-7/2; polished 2.5Y 5/2 and 6/2; ring 2.5Y 4/2.
Shrinkage	Dry size: No. 17a—8.75 x 4.28 cm; 10.53 x 12.30%. No. 17—8.52 x 4.51 cm; 10.97 x 11.05%. Mean—10.75 x 11.68%

FIRING

Temperature	No. 17a—910° C, oxidizing on 1/26/82. No. 17—1250° C, 5/28/82
Fired color	No. 17a—7.5YR 7/6; rind 5YR 8/3. No. 17—7.5YR 5/4; rind nearly white
Fired size	No. 17a—4.28 x 8.68 cm. No. 17—4.36 x 8.03 cm; 3.3 x 5.8% further shrinkage

Fired properties No. 17a—a few apparently new very small (ca. 2 mm), fine cracks in the polished area on top of the tile. One crack in the back now measures 17 mm in diameter, although the tile sounds all right. No. 17—shiny and dense; no further cracking apparent. Rind contrasts markedly with the clay color.

CLAY SAMPLE DATA: SAMPLE NO. 18

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NE 1/4 of SE 1/4 Section 12 T21N, R11W, 6300'
Description	Taken from the drainage that comes from Jackson's staircase and runs to Chetro Ketl, from the vicinity of the large prehistoric "retaining walls." Taken from the same bench as the retaining wall/alignment; about 200 meters from its east end. This sample comes from 1 stratum up from No. 17.

DEPOSIT

Formation	Cliff House.
Description	Several exposures of this lighter gray layer are present at the base of the cliff. The material where exposed to rain looks very clayey, but contains much sandstone and the clayey portions are much sandier than the other clays collected from outcrops.
Date/by	9/19/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 12/2/81 at 3:00 p.m. Rapid breakdown; fairly smooth by 10:00 p.m. Small plates still visible on 12/9 in the a.m. Smooth and homogeneous by the end of soaking on 12/11. No crystals formed at the water line.
Settling	Column started on 12/11 at 7:40 a.m. Initial settling of sandy fraction to the bottom is rapid. At 8:20 a.m. on 12/14, film on surface; 19 mm pale yellow transparent water; 9-10 mm very fine sediment with minimal specks; 20 mm brown sediment with variation in the amount of dark areas. Dark particles are very fine and look more like sand than coal; 0-1 mm band of dark material at bottom.
Wet color	2.5Y 5/2
Hydration	Water mostly evaporated on 12/11. Mixed and placed under plastic on 12/11 in the p.m. Plastic removed, placed under towels on 12/14 in the a.m.; on 12/14 at 11:30 a.m., very wet.
Tile	Formed on 12/15 at 8:00 a.m. No. 18a—9.95 x 5.07 cm. No. 18—10.59 x 4.74 cm.
Workability	This clay is quite sandy. Fillets, rings, pinch pots can be formed but the cohesiveness of the clay seems low. It is also sandy enough that it scrapes better with a serrated edge than a straight one.
Polishing	Hard enough by 12/15 at 3:30 p.m. to be polished with the tumbled polishing stone; the coarser stone smears the clay. Reasonable polish. Too dry to polish by 8:00 a.m. on 12/16.
Drying	Dry by 12/17 in the a.m. Dried smooth and without cracks; shrinkage low.
Dry color	10YR 7/2
Shrinkage	Dry size: No. 18a—9.35 x 4.83 cm; 6.03 x 4.73%. No. 18—9.89 x 4.49 cm; 6.61 x 5.27%. Mean: 5.00 x 6.32%

FIRING

Temperature	No. 18a—910° C, oxidizing, 1/26/82
Fired color	No. 18a—5YR, 7.5YR 7/6; polish the same.
Fired size	No. 18a—4.84 x 9.36 cm
Fired properties	No visible cracks; sounds good.

CLAY SAMPLE DATA: SAMPLE NO. 19

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of NE 1/4 Section 28 T21N, R10W, 6260'
Description	Taken from the backhoe trench spoil for the waterline from the utility area to the Gallo Campground. From the surface the area looks like talus; the backhoe exposes an unweathered clay deposit. Site 29SJ 601 is nearby.

DEPOSIT

Formation	Menefee
Description	A thick, hard, gray clay stratum is present. It appears to grade to shale. Some selenite crystals and coal are visible in the clay.
Date/by	5/20/82 by H. Wolcott Toll, Thomas C. Windes.

TREATMENT

Soaking	Placed in tap water on 6/15/82 at 1:00 p.m. Rapid absorption; abundant black specks float off. At 4:30 p.m., some lumps remain; mixed. Small amount of water added on 6/21 in the a.m. No crystals form at the water line.
Settling	Column started on 6/22 at 1:00 p.m. from viscous clay; little settling after one hour—1-2 mm water. At 2:30 p.m. on 6/23, a few clay islands on surface; 4 mm transparent mildly yellow-brown water; 2-3 mm slightly lighter layer at top; 43 mm homogeneous yellow-brown clay with rare dark (not black) specks; no layering. Second column begun on 6/23 with more water; similar result but with incomplete bands of dark material at bottom.
Wet color	10YR 6/3
Hydration	Wet towels at 1:00 p.m. on 6/22. Yellow staining occurs on towels.
Tile	Formed on 6/23 at 2:00 p.m. No. 19a—9.43 x 4.89 cm. No. 19—9.78 x 5.03 cm.
Workability	Good; small lumps of sandstone drag in scraping, but cause no problem. Can be filleted and formed into pinch pot. 55 repetitions of balling and pinching were performed. Clay can still be formed but was becoming stiff; cracking began at around 25 repetitions, but by any account this is good workability.
Polishing	No. 19a put under plastic on 6/23 at 5:00 p.m. Removed on 6/24 at 8:00 a.m. More or less leather hard on 6/24 at 3:00 p.m., though somewhat plastic(?). Polishes with some smear; repolished at 4:30 p.m. on 6/24 with better results.
Drying	No. 19 fully dry by 8:00 a.m. on 6/25. Both tiles dried with no cracks and with no distortion.
Dry color	10YR 7/2, polish somewhat darker, 6/2-7/2.
Shrinkage	Dry size: No. 19a—8.64 x 4.52 cm; 8.38 x 7.57 %. No. 19—8.90 x 4.67 cm; 9.00 x 7.16%. Mean: 8.69 x 7.37%

FIRING

Temperature	No. 19a—950° C, 10/26/82
Fired color	No. 19a—7.5YR 8/4 (best match), Windes, Group 2.
Fired size	No. 19a—8.65 x 4.53 cm.
Fired properties	No cracks, good sound. Some white rind at edges of polish. A few shaley looking inclusions are a deeper reddish color.

CLAY SAMPLE DATA: SAMPLE NO. 20

LOCATION

Quad	Pueblo Bonito, NM 1966
Legal	NW 1/4 of SW 1/4 Section 2 T21N, R11W, 6260'
Description	Taken from the base of the sandstone stratum in which Atlatl Cave is located. The closest surveyed site is 29SJ 1159.

DEPOSIT

Formation	Cliff House.
Description	Pockets of hard gray clay are present. Some is weathered but only unweathered was collected.
Date/by	5/22/82 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 6/15/82 at 1:00 p.m. Rapid absorption, little floating material; lumps dissolved by 2:30 p.m. Smooth and homogeneous on 6/22; no crystals form at water line.
Settling	Column started on 6/22 at 1:00 p.m. from viscous to runny clay. After one hour, 14 mm water at top with some dark material at bottom. At 2:45 on 6/23, film with one black speck on the surface; 15 mm transparent, nearly colorless water; top of sediment cloudy with pin prick holes; 3 mm somewhat lighter than main sediment; 28 mm very homogeneous, dark, gray clay; 1 mm dark, very fine particles.
Wet color	10YR 4/2
Hydration	Column returned to main sample at 2:45 p.m. on 6/23. Wet towels at 8:00 a.m. on 6/24; plastic loosely over towels at 4:30 p.m. on 6/23.
Tile	Formed on 6/25 at 8:15 a.m. No. 20a—10.07 x 5.03 cm. No. 20—9.53 x 5.15 cm.
Workability	Good. Fillets and pinch pots can be formed with only minor cracking at the edge. Ball and pinch test 30 repetitions. Could have continued, but cracking was increasing. Smooth, malleable and easily scraped.
Polishing	No. 20a—first polishing on 6/28 at 12:00 p.m. Takes polish with some smear; polishes well at 3:00 p.m. No. 20a was placed in plastic at 4:20 p.m. on 6/25 and removed at 8:30 a.m. on 6/28.
Drying	Both tiles crack free and free of distortion.
Dry color	2.5Y 6/2. Polish 2.5Y 5/2
Shrinkage	Dry size: No. 20a—9.06 x 4.65 cm; 10.03 x 7.60 %. No. 20—8.60 x 4.69 cm; 9.76 x 8.93%. Mean: 8.25 x 9.9%

FIRING

Temperature	No. 20a—10/26/82; 950° C.
Fired color	No. 20a—7.5YR 7/6 (Windes Group 4)
Fired size	No. 20a—9.07 x 4.65 cm
Fired properties	Not recorded.

CLAY SAMPLE DATA: SAMPLE NO. 21

LOCATION

Quad Kin Klizhin Ruins, NM 1966

Legal SE 1/4 of SW 1/4 Section 21 T21N, R11W, 6280'

Description Taken from a large piping (?) cavity in one of the extensively exposed clay strata in a badland complex in part of the proposed south addition to the park. Sites in this vicinity are mostly Navajo, though Anasazi (especially early) sites are also present.

DEPOSIT

Formation Menefee

Description There is extensive weathered, gray clay on the slopes in this location. The clay collected is mostly unweathered. It was from the ceiling of one of the many cavities in the clays here.

Date/by 5/8/84 by H. Wolcott Toll

TREATMENT

Soaking Placed in Chaco Canyon tap water on 5/8/84 at 5:00 p.m. Lumps were somewhat slow to break up, but by the next afternoon, most had done so. Working the sample broke up some remaining hard lumps of clay and revealed some large concretion-like inclusions (8 x 7 x 4 cm; 8 x 3.5 x 2 cm).

Settling Column started on 5/14 at 12:20 p.m. from wet clay. Some platey fragments not in solution. Little change other than light to dark areas by 3:30 p.m. On 5/15 at 1:20 this mixture had too much clay in it to fully settle though there are < 1 mm dark specks (local?) at the bottom, in one area and an irregular (1-13 mm) layer of darker clay at the bottom as well. The remainder of the column is mostly homogeneous brown with a few lenses of darker material. There is no water layer at the top. This mixture can be poured so the complete suspension does suggest very fine particle size.

Second column with less clay on 5/14 at 2:20. By 3:30 p.m., distinct dark layer at bottom and some water separation at top.

On 5/15 at 3:00 p.m., 2nd column, no surface film; 3 mm cloudy but light-colored water; 4 mm brown-yellow, cloudy but translucent water; 35 mm brown, homogeneous suspended clay/water; 3 mm slightly lighter colored sand (silt?); 6 mm darker gray-brown band (variable thickness) with 1-4 mm lighter colored specks visible; a few black specks also visible.

On 5/22 at 4:00 p.m.—the column is much the same even now, though more layering is visible; 9 mm water grades from clear to brown transparent with some layering; 3 mm clear water; 36 mm homogeneous brown; 4 mm darker brown with particles. Reshaken and half poured off and replaced with water at 4:15 p.m. on 5/22.

On 5/23 at 4:30 p.m.—3 mm clear water; 9 mm brown translucent-transparent; 1 mm very distinct, lighter brown; 2-3 darker brown at bottom.

On 5/29 at 4:30 p.m.—9 clear grades to 5 clear brown, 9 darker clear brown, 23-4 light brown opaque, 3 darker brown.

On 6/4 in the p.m.—16 dark yellow-brown transparent water grade to 6 light brown. Colored area with less sediment into homogeneous light brown to three darker; two darkest.

Wet color	2.5Y 4/2.
Hydration	Cohesive wet clay brought from Chaco to Albuquerque in plastic bag. Under towels beginning on 5/15 in the p.m., with return of some of settling solution. Sticky on 5/16 in the p.m.
Tile	Formed on 5/17 at 1:20 p.m.. No. 21a—10.21 x 5.24 cm. No. 21—10.10 x 4.81 cm.
Workability	A small "Lino seed jar" was made using this clay and some very coarse, angulate sand temper on 5/10/84. With this temper, a very coarse pot resulted and many drying cracks formed. Most cracks on one surface only, but when completely dry one crack base goes completely through. On 5/16—clay dries slowly. Will form knot 5/16 p.m., but still is too sticky to work well. 30 repetitions of ball test. Pinch pot possible; still somewhat sticky. This may have been worked when the clay was too wet.
Polishing	Takes polish quite well with some smearing 5/18 in the p.m. Polished area is darker than remainder when tile is dry.
Drying	Room temperature on 5/18 in the a.m. is 75° F. Slow to dry and tends to warp while doing so by 5/18 in the a.m. There is a crack in the end of No. 21a (tile still quite wet). Drying appears complete by 7/21 in the a.m. Both tiles have a crack through the entire thickness running across the width of each at the precise middle. No. 21 has few other cracks, small parallel to major mid-line crack and some around incised number. No. 21a has major (25 mm long x 1 width) longitudinal crack that shows on both sides. Cracking and stickiness are reminiscent of No. 4; the properties may result from weathering of the deposits.
Dry color	10YR 6/2.
Shrinkage	High. No. 21a—8.80 x 4.51 cm; 13.81 x 13.93%. No. 21—8.73 x 4.20 cm; 13.56 x 12.68%. Mean: W=13.31 x L=13.69%

FIRING

Temperature	910° C, 4/17/85.
Fired color	No. 21a 5YR 7.6. On 4/17/85 distinct grayish tinge.
Fired properties	Tile broke <u>before</u> firing; firing does not seem to have furthered the cracking. See mix of 21 and 10.

COMPARATIVE CLAY SAMPLE DATA: SEDIMENTARY CLAY FROM NEAR SAN YSIDRO

LOCATION

Quad	San Ysidro
Legal	T16N, R1E ca. 5800'
Description	Taken from the first red cutbank on the west side of NM 44, 8.9 miles from the San Ysidro/Salado River bridge (travelling toward Cuba).

DEPOSIT

Formation	Morrison
Description	A dark red-brown deposit that also contains greenish white lenses. Weathered in this location at the surface. This sample is largely pea-size or smaller lumps, ranging up to 2-3 cm.
Date/by	12/12/81 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water on 12/15/81 at 8:40 a.m. Soaks up and breaks down immediately. Water present on 12/17 at 5:00 p.m. Put under plastic; uncovered on 1/1/82.
Settling	Column started on 1/4/82 at 8:15 a.m. Rapid initial settling. On 1/3 at 8:30 a.m.—a few isolated particles on the surface; rootlets at the water line; 22 mm clear, nearly colorless water; 9 mm very fine, homogeneous red-brown sediment; 4 mm slightly darker and slightly coarser, lacks interstitial spaces; 12 mm slightly browner, with fine interstitial spaces; homogeneous except for slight gradation to coarser. No specks are visible.
Wet color	2.5YR 3/6.
Hydration	Placed under towels 1/6/82.
Tile	Formed on 1/6/82 at 2:15 p.m. SYa—9.53 x 5.24 cm. SY—10.28 x 5.31 cm.
Workability	Somewhat grainy and "short." Does fairly well on the repeated forming and squashing test. Will form a fillet and a ring but will not knot. Outside of ring cracks even though clay is somewhat wet. Will form a pinch pot but the clay is somewhat flaccid and subject to cracking. Granularity causes irregularity in incising.
Polishing	Dry enough to take some polish on 1/6 at 8:30 p.m., but smears. Polishes well on 1/7 at 7:45 a.m.
Drying	Both tiles dried with slightly rough surface and with visibly less shrinkage than other clays. SY is crack free, but SYa has one small crack system on the back and numerous very small cracks on the polished area on the front.
Dry color	10R 5/6; polish 10R 4/6-5/6.
Shrinkage	Dry size: SYa—8.90 x 4.90 cm; 6.61 x 6.49%. SY—9.56 x 4.95 cm; 7.00 x 6.78%.

FIRING

Temperature	SYa—910° C, 1/26/82. SY—1250°, 5/18/82.
Fired color	SYa—2.5YR 5/8; polish slightly darker. 2/5YR, 2.5/4.
Fired size	SYa—8.75 x 4.81 cm; 1.69 x 1.84%; further shrinkage. SY—±7 x 12.5 cm melted.
Fired properties	SYa—the day after firing, extensive hairline cracks were visible in the polished area and some cracks visible on the back of the tile. Several days later the tile had broken into three distinct pieces radiating from a single point and many crumbs. At this point in the center of the tile is a large white inclusion as the days following firing were humid for NM. I suspect this white thing may have expanded. This white material is now powdery. SY—this was by far the most severely affected tile at 1250°. It flowed into a vesicular puddle which we had to chip at the kiln shelf. Its appearance is aptly compared to an overdone brownie (with some unsavory yellow inclusions).

It is noteworthy that the only three tiles that shrunk further with firing are the three control samples. These were the best formed so they may have not fully dried in the cool weather but they did seem dry. It is more likely to relate to their very different sources.

COMPARATIVE CLAY SAMPLE DATA: RIVERINE CLAY FROM ALBUQUERQUE

LOCATION

Quad	Albuquerque West
Legal	T10N, R3E 4900-5000', Section 30.
Description	Collected from about 50 cm below present ground surface in the front yard of 816 El Serano Court SW, Albuquerque.

DEPOSIT

Formation	Riverine/alluvial
Description	This is a sample of the dense red-brown clay common in this part of the South Valley of Albuquerque. There are occasional areas of denser clay and of lighter clay; this was collected as lighter clay but is quite brown. The area is in the flood plain of the Rio Grande but this deposit must be well over 50 years old as it clearly antedates the house. A tree stump was being removed from the area when this sample was collected, so there is substantial organic material.
Date/by	6/81 by H. Wolcott Toll

TREATMENT

Soaking	Placed in tap water on 12/2/81 at 3:00 p.m. Clumps retain shape but can be broken by 10:00 p.m. Lots of roots, both large and small. Small lumps remain on 12/9 in the a.m. No crystals form but there is a marked bath tub like ring.
Settling	Column started on 12/14 at 9:00 a.m.; slow to settle. On 12/15 at 9:00 a.m., no surface film; 3 mm somewhat clouded water; 3 mm fine sediment about the color of the main sediment; 9 mm darker band—subtly but definitely different from the one below; 33 mm of homogeneous reddish-brown deposit; no heavy fraction visible at bottom. This is clearly a non-settling hydrophilic sample. There is minimal separation from the water.
Wet color	2.5YR 5/2.
Hydration	Allowed to go slightly over-dry one end by 12/14 in the a.m. Small amount of water added; remains sticky even when getting stiff on 12/15 in the a.m.
Tile	Formed on 12/15 at 1:15 p.m.—ElSAQa—9.90 x 4.81 cm. ElSAQ—10.02 x 5.08 cm. Mica visible.
Workability	Especially where the clay has been exposed for a while, this sample has good working qualities. It is very cohesive, easily formed into fillets, coils and pinch pots with minimal cracking. Where still wet (toward the center of the mass), it is gummy and sticky, in good hydrophilic fashion.
Polishing	Turned face down overnight. Polishes on 12/16,at 8:00 a.m. with tumbled polisher but smears; much better response at 9:30 a.m.
Drying	Both tiles dried cohesively and crack free. Mica is visible on the surface of both tiles.
Dry color	5YR 6/2, polished very slightly darker.
Shrinkage	Dry size: ElSAQa—8.77 x 4.25 cm; 11.41 x 11.64%. ElSAQ—8.95 x 4.54 cm; 10.68 x 10.63%.

FIRING

Temperature	ElSAQa—910° C, 1/26/82. ELSAQ—1250°, 5/18/82.
Fired color	ElSAQa—2.5YR6/8. ElSAQ—2.5YR, 2.5/4.
Fired size	ElSAQa—8.68 x 4.20 cm (1.18 x 1.03% further shrinkage). ElSAQ—9.2 x 4.8 cm, imprecise.
Fired properties	ElSAQa—one very small crack; looks and sounds good. ElSAQ—half of the tile is severely

bloated. Large vesicles, distortion, flow, stuck to shelf. The other half (bottom) has a shiny, brown-red with grading of vesicle size on the top. This can be explained by the fact that this piece was on the bottom of the kiln, half sticking out from under the second tier. Clearly the heat is somewhat different below the shelf.

COMPARATIVE CLAY SAMPLE DATA: ALLUVIAL CLAY FROM COMMANCHE SPRINGS

LOCATION

Quad	Tome NE
Legal	T4-5N, R3E
Description	From the arroyo bank above and to the east of the spring.

DEPOSIT

Formation	
Description	When collected, this clay comes in large, smooth lumps of almost a pure clay. It is a rich red-brown with lines of a gray green (Morrison-like) color shot through like cream in coffee.
Date/by	1972 by Peter J. McKenna

TREATMENT

Soaking	Placed in tap water on 12/10/81 at 9:00 a.m. Breaks down extremely quickly into platy mass; roots are present. The soaking clay gives off a strong clayey/dusty smell, unlike any of the Chaco clays. Oatmealy appearance remains on 12/10 at 1:00 p.m., as does the smell though the clay is completely submerged. Plates disappear with mixing on 12/16 in the p.m.
Settling	Column begun at 1:00 p.m. on 12/16. Initial settling rapid. By 3:30 p.m. on 12/17, no surface film; 18 mm transparent, yellowish-pink nearly clear water; 2 mm lighter, finer sediment; 16 mm light red, quite homogeneous sediment with some dark and light specks; 12 mm coarser grained with abundant black and green-white specks.
Wet color	2.5YR 5/4
Hydration	Most water evaporated or wicked off by 12/16 at 1:00 p.m. Placed under paper towels on 12/16 at 9:00 p.m. Placed in plastic bag on 12/17. Still sticky at 5:00 p.m. on 12/17.
Tile	Formed at 8:00 p.m. on 1/3/82: CSa—4.60 x 9.45 cm. CS—4.83 x 9.86 cm.
Workability	Excellent—can be coiled, filleted, knotted and forms pinch pots with ease.
Polishing	Smears somewhat at 8:00 a.m. on 1/4. Polishes well at 10:30 a.m. on 1/4. Still damp on 1/5 at 9:30 a.m. Takes on a high sheen at this time.
Drying	This sample is slow to dry and bends when doing so. CSa developed a crack across the entire midsection and this eventually separated. This is the area in which the last polishing attempt was made and this may have stressed the tile. CS dried smooth and crack free.
Dry color	5YR 5/4 polish same; last polish the same on 5/4-6/4.
Shrinkage	Dry size: CSa—8.18 x 3.94 cm; 13.44 x 14.35%. CS—8.52 x 4.18 cm; 13.59 x 13.46%.

FIRING

Temperature	CSa—910° C, 1/26/82. C—1250° C, 5/18/82
Fired color	CSa—2.5YR 6/8. CS—top 10R 4/4. Side—10R 4/6. Red.
Fired size	CSa—3.84 x 7.97; 2.54 x 2.57%; further shrinkage. CS—4.40 x 8.80 cm; expanded.
Fired properties	CSa. Further extensive cracking developed with a spall from one corner. A long crack runs all along one edge. More immediate post-firing damage visible in this tile than in any of the other samples. Since CSa experienced some problems at 910°, I anticipated more at 1250°; but effects were minor. The tile is intact and shows no distortion past a few small blisters. There are a number of tiny black spots where small pockets have vitrified and flowed.

Appendix 2D

Statistics

Table 2D.1. Summary of statistics and symbols used in ceramics chapter.

Statistic	Symbol	Derivation and Use	Reference
NOMINAL DATA			
Chi-square	χ^2	Tests for significant difference from the statistically expected distribution of attributes among categories.	Siegel 1956:175
Contingency coefficient	C	Measures the strength of association based on the χ^2 distribution and controls for sample size; directly comparable only for contingency tables of the same size.	Siegel 1956:196
Fisher's Exact Test	p	Calculates the probability (p) that two samples are the same for two variables; used for small samples.	Siegel 1956:96
Diversity	H'	$H' =- \sum_{i=1}^{s} pi \ln(pi)$ Measures the distribution of items in various categories (types, species) in a given sample; based on the natural logs of the percents (pi) in the categories.	Pielou 1969:229; Lasker 1976
Evenness	J	$J = \frac{H'}{H'_{max}}$ Compares the maximum possible value of H' with the actual value to give an index of the evenness of distribution (0=all in 1 category, 1=same percent in each category).	Pielou 1969:229
Richness	s	Used in conjunction with H' and J; the number of categories present	Pielou 1969:229
Coefficient of Jaccard	S_J	Gives an index of similarity between two groups based on the co-occurrence of attributes.	Sneath and Sokal 1973:131 Toll and McKenna 1987:72-73
ORDINAL DATA			
Spearman's Rank Order Coefficient	r_S	Gives a coefficient of correlation between two groups that can be ordered on the occurrence of some attribute, or one group ranked by two variables.	Siegel 1956:202

Table 2D.1. (continued)

Statistic	Symbol	Derivation and Use	Reference
INTERVAL DATA			
Mean	$\bar{x}$	The average of a series of values (the sum divided by the number).	---------
Coefficient of Variation	CV	The standard deviation divided by the mean; gives a standardized value for variability expressed as a percent.	Thomas 1976:82
Standard deviation	sd	Measures the dispersion of cases around the mean and the variability of the sample; the percentage of cases falling within given numbers of standard deviations from the mean is known.	Kushner and DeMaio 1980
Pearson's correlation coefficient	r	Shows the strength of relationship between two variables, expressed as positive or negative; the probability (p) of the two variables being unrelated for a given sample size can be determined.	Kushner and DeMaio 1980: 188-198
Student's t-test	t	Compares the means of two groups to determine whether the two are likely to be from the same or different populations.	Kushner and DeMaio 1980:156
F test	F	Compares the variance estimates for two samples as a ratio in order to determine whether or not the variances are the same; the result is compared to a known distribution.	Kushner and DeMaio 1980:175
ABBREVIATIONS			
Degrees of freedom	df	Calculated variously for different statistics; concerns "the number of parameters that are allowed to vary" after "certain restrictions are placed on the data."	Kushner and DeMaio 1980:260; Siegel 1956:44
Probability	p	Gives the likelihood that a larger value will be obtained for a certain statistic given the df of the sample (see also Fisher's exact above).	

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